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Sub-Presses and Compound Dies.

BY A. H. CLEAVES.

The utility of the sub-press may be appreciated by examining the accompanying illustrations and descriptions of actual cases in practice. They explain the character of the punches and dies used for making the wheel and balance punchings used in watch-making, as well as many

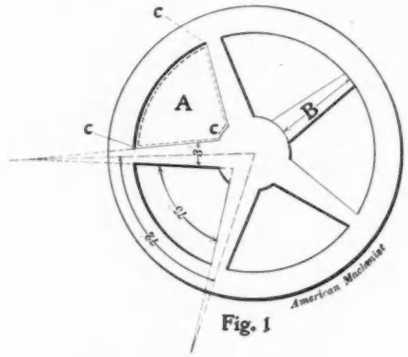


Fig. 1

WATCH WHEEL BLANK.

of the methods employed in doing the work.

In these two dies the plunger is $1\frac{6}{10}$ inches in diameter; the whole sub-press when the punch and die come together is but 7 inches over all in hight; while in the die for the smaller or escape wheel and wheels for ladies' watches the plunger is only $1\frac{1}{10}$ inches in diameter. This represents a good deal of capacity, and diversity of parts in a small space, and reflects no little credit on the designer, whoever he may have been.

These dies, when properly made and used, will do long and faithful service, punching the wheels out of spring brass, and will turn out 500 punchings a day for a good many years. The balance, being of steel, has a harder work to perform, but will do a great amount of it.

For the high-grade watches the wheels are shaved, or punched a second time; a punch and die called the "shaving-die," and in construction nearly the duplicate of the one shown, being used for this purpose. In Fig. 1 the space *A* with dotted lines shows where the first punching is shaved.

The wheel stock, being only two or three hundredths thick, makes a comparatively smooth punching; so that $\frac{2}{1000}$ shaved from the first punching where the dotted lines show will leave a beautiful finish—in fact, a polish if the die is made smooth on its sides. This was done formerly with a file and was called "crossing," and, compared with the work of a shaving-die, was very inferior.

In shaving thicker brass punchings, provision must be made for deeper breakage on the edges, especially on small convex curves and projecting points. Thus, on Fig. 2, a punching $\frac{1}{8}$ of an inch thick and the circle at *A* to be finished $\frac{19}{100}$ inch, would require two shavings, each $\frac{1}{100}$ inch.

The edges of the blank punching at the concave curves *B* and *C* came nearly smooth like *F*, while the one at *A* came broken like *G*. So the circle on blank was $\frac{21}{100}$ inch, then it was shaved to $\frac{20}{100}$ inch, and the next time to $\frac{19}{100}$ inch. I found by experiment that trying to shave the $\frac{2}{100}$-inch at once on this point would break the stock out and necessitate shaving again. The pionts *D* and *E* pull down badly and must be left with surplus to shave off and turn off on top.

Shaving this kind of work is a great improvement on profiling, both for finish

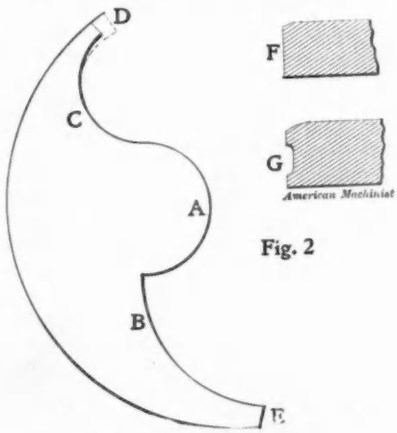


Fig. 2

RESULTS OF SHAVING.

and accuracy. The latter being especially important where the finished pieces are to be held positively in jigs or chucks for further operations.

Good results in shaving punches depend on having the inside surfaces of the die highly polished, and the face of the die very smooth. The clearance should be trifling, and on wheel-dies the sides of the die are perfectly straight. While the cutting edges are very sharp, the polished surface of the die acts as a burnisher on the brass, giving it a superfine finish.

Let Fig. 1 represent a watch-wheel blank not over $\frac{1}{32}$ thick; then the first punching will be like the figure, and the shaving die will trim out the stock in each division as shown by the dotted lines in the space *A*. The angle of the wheel-arms being 3 degrees, the angle of the punches for the spaces will be 75 degrees, the center of the wheel and the vertex of the angle being in different positions, and the angles on arm radii being 72 degrees.

Fig. 3 gives a sectional view of plunger and base of sub-press containing the works of a wheel-die for the first punching. The cap *A* is screwed into the plunger and has a hole through the center, as sometimes the stock not being well oiled a punching may stay in the die, when it can be driven out by taking the sub-press out of the large press and striking a blow on the top of the shedder-pillar *B* through a rod inserted at the hole in *A*.

If it is found that the punches remain in the die owing to the weakness of the spring, then the cap *A* must be removed and the spring stiffened by screwing down the plug *C*. This plug is provided with two holes for a pin-wrench screwdriver like one shown in Fig. 4.

The spring *D* is made of square tool steel wound while hot around an arbor and opened by driving a cold chisel between the coils. It should be wound like a left-handed screw; then it can be reamed out in the center, soldered onto an arbor, turned off and squared up on the ends, filed up and nicely finished. If wound right-handed the lathe tool will catch on the end coil of spring and tend to uncoil the same, and raise a "splogastic presumption" generally.

These features for pushing the punchings out of the die are general in this method of doing punch and die-work, and apply to a good many cases where the requirements are similar.

By making the spring in this way and compressing it with a plug and screwdriver as shown, a very stiff spring can be used and a good deal of energy packed into a very small space. It will be seen that this use of the spring can be adapted to other cases in general practice, and so may be worth remembering.

The rest of the details in the drawing, excepting *E* and *F*, parts of the sub-press, may be said to belong to the punch and die proper. *G* is a soft-steel socket for holding the upper parts of the die. In this case, allowing the die to be the part which gives the form to the work, the die

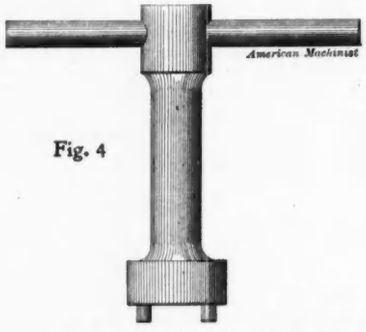


Fig. 4

KEY WRENCH FOR SUB-PRESS.

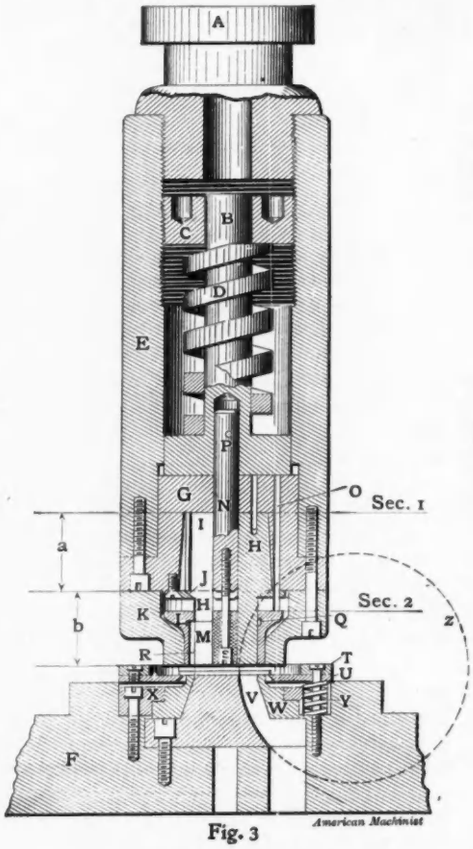


Fig. 3

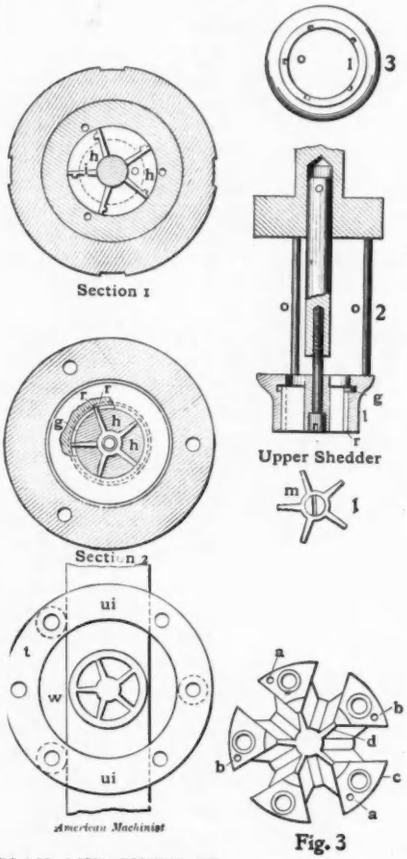
SECTION OF SUB-PRESS DIE.

is above, and movable with the plunger; while the punch is stationary and below, or in the base of the sub-press.

There are five pieces *H H* shown open and in section which punch out the waste pieces from spaces like *A*, Fig. 1, in the wheel. (See section 1, *h h*.) These are the pieces in the shaving die that require to be perfectly smooth, as they give the finish to the edges of hub, arms and inside of rim to wheel.

I (see *i*, sec. 1) is one of five slips that go between the sections *H H* to give the form to the wheel arms, being of 3 degrees angle. A part of their horizontal section corresponds to *B*, Fig. 1. An end view of these slips is shown in section 1. This slip, compared with the die-section *H*, reaches the distance *a*, Fig. 3; while *H* itself extends the length *b*, Fig. 3. So that the five slips, with the five sections, make a solid mass as shown at section 1, leaving spaces the shape of wheel-arms between the sections *H* for the distance *b*, Fig. 3.

The sections *H* and slips *I* are held in the socket *G*, mostly by friction, being fitted closely and pressed in; but for further safety by the little steel collar or plate *J*, *K* is for cutting the outside rim of wheel punching. It should be located by a shoulder on *G*, not shown in the drawing. Screws for holding this piece pass through *G* into *E*, the plunger. *G* and one of the sections *H* must be located with dowel-pins.



PLAN AND GUIDE OF LOWER SHEDDER.

The shedder (see details named "upper shedder," "plan of guide," "lower shedder" and section 2) is a device for throwing the wheel punching out of the die and forcing it back into the stock again, or the strip of brass from which it was punched. The waste pieces at *A*, Fig. 1, go down through the opening in *V*, Fig. 3. (See also Plan of *V*, Fig. 3.) That part of the upper shedder marked *L* (see detail *l* 2 and *l* 3, "upper shedder") is a cylinder of tool steel tempered, and of the shape shown in section 1, Fig. 3. A groove *Q* is turned in it, and five grooves like *R* are planed in the interior of *L* until they meet *Q*. (See *q* in detail of upper shedder, *Q* and *q* in section 2, and *r* in the same detail drawings.)

m is a piece like the wheel without the rim. It has a hub and five arms a little longer than the wheel arms, the excess in length filling the grooves *R* and resting on the seat furnished by the groove *Q*. (See *m* in detail of upper shedder 1.)

A number of pins like *O* (see *o* in detail of upper shedder 2) pass through *G* and *J*, touching *L*; being of such a length that they hold the bottom of *K* and *L* in the same plane when the bottom of *B* is in contact with the top of *G*. Then the rod *N* being pinned in *B* as shown at *P*, the screw *S* passing through the hub of *M* locks the whole shedder, making it as one piece. So the pieces *B N O L M S* all move together. This can be seen best in detail of upper shedder 2, where the several parts are practically one piece.

When the wheel punching enters the die the spring *D* is compressed, and when the die leaves the punch the spring forces the wheel out again; but the spring pressure comes on the top of the socket *G*, leaving no service for the small screw *S* but that of locking the parts; the upward pressure being sustained by the pins *O* and seat *Q*.

In the lower works, or punch in this case, *T* is a ring or plate attached to *U*, as shown by a small screw on the left. (See *t* in detail of same.) This has an opening on the under side about half its thickness for guiding the stock. (See *u i* in detail of lower shedder.) *U* is the lower shedder, and pushes the stock from outer rim of *W*, which is accomplished by three small springs like the one shown on the right. The three shoulder screws prevent the shedder from rising above the top of the punch. It will be noticed that the springs are not very strong, and do not require to be, as the wheels being punched close to the edge of the stock relieve the binding friction on the rim of *W*. *V* is the web of punch corresponding to the hub and arms of the wheel, and *W* is the punch for the rim; *Y* being a soft steel ring for holding *W* on *V*, the latter being screwed and doweled to *F*. (See plan of *V*, Fig. 3.)

In the plan of *V*, Fig. 3 (a detail), will be seen two dowel-pin holes *a a* and *b b*. I use two for locating *V* while fitting the same to die, and the other two for resetting after tempering; which I will describe further under methods of making the dies.

I said one of these dies on wheel work would be serviceable for many years, getting out several hundred per day, probably for twenty years; but I should have limited the statement to the upper or sectional part of the die, as the lower parts *V* and *W* require to be renewed occasionally for the following reason: It will be noticed that the piece *W*, which punches the rim of the wheel, is turned off on the outside, not only to enter the die *K*, but to allow the shedder *U* to pass down something more than the thickness of the

stock on the outside. This makes the stock in *W* contracted here, as it must be, to avoid coming too near the inside angle on *W* and weakening the punch. This point is worth keeping in mind for general use; for these limits grow out of the fact that a die with thin or narrow rim cannot be deep, whether brass or steel is punched, and clearance does not help it. That is, it will not do to have more than one or two of the waste punchings (in this case) in the straight part of *W*, as they expand and burst the die. This requires economy in grinding or sharpening the lower die; but when made properly, they will do long service on thin stock.

In Fig. 12, the same thing is shown clearly; *A* being a steel regulator punching made in a compound die, and the center stock at *B* passes down through *C* and out. The stock at *D* being thin, if more than one punching is retained there, it splits the shell at *D*. Tapering the hole out with a broach or reamer will not work as in a solid die. I have had such a die as the above punch out over a hundred thousand pieces without injury. The advantage of punching work in this kind of a die is found in the fact that the punchings are perfectly flat, being held in shape by the stiff shedders; while if punched in dies that make the hole at one punching, locating by the same with a pilot-pin or guide for the second punching, the stock is drawn down and distorted, in pieces of this shape, and they cannot be flattened again to compare with the other work.

In Fig. 3, *Z* shows the diameter and position of the cutter used for milling out the spaces in *V* (see also in detail of *V*) like the form *c c c* in Fig. 1. This cutter leaves a little surplus on the sides of the web-arms to shave to size by the proper die before tempering.

Figs. 5 to 11 illustrate the method of making the sections in the upper part of die. When the sections are made to be used with separate slips between them to shape the arms, a piece of square steel, Fig. 5 (dotted lines) is blocked out in a shaper, being long enough to cut up into the five section pieces.

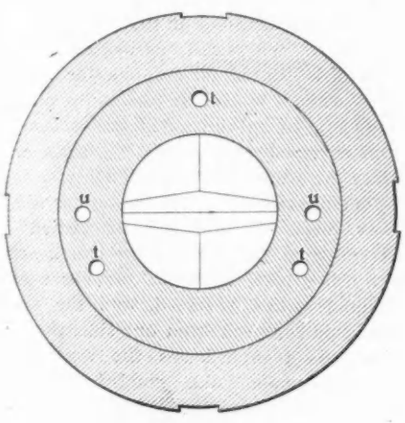
A fine graduating machine, for the planer or milling machine use, is put on the planer, the graduating machine having a large bore for taper shank. A long arbor with taper shank is held firmly in the graduating machine, the round straight part being long enough to receive the piece to be planed for sections.

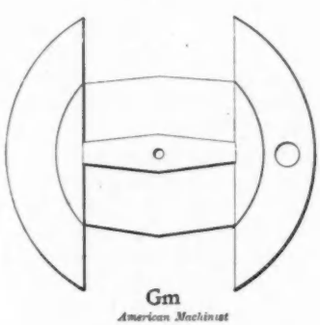
The arbor is planed as shown in Fig. 8 *A*, and a section-strip *B* is soldered on and planed to shape as shown, the angles being obtained with the graduater. *B* and *A* are tinned over at *C* and clamped together while hot, two alcohol lamps being place under *A* to heat it. When cool, the work being revolved 72 degrees brings *E* in the horizontal plane, and planes it true with *C*, laterally. The same arbor is used for planing the slips *A*, Fig. 9, and in the same way, substituting 3 degrees for 72 degrees. The blank stock must be thick enough to solder down the whole length. (See dotted lines, Fig. 9.) The finishing cuts on all these pieces must be very light to prevent any spring in the arbor.

The groove in the section, and rib on the slip shown at *B*, Fig. 5, must be located carefully, as they determine the width of the arm, or the stock must be planed to a gage at some point like *A*, Fig. 5, corresponding with arm in the wheel punching at that place.

A, Fig. 6, is one of five steel blocks, cut from a piece planed to proper angle, and screwed to face plate of lathe in a circle. (See *a, a, a, a, a*, in detail of grinding method.) The section pieces *B* are soldered onto *A*, where they extend over (see *b b*, detail of same) and are all ground together after being hardened. In soldering these pieces onto the blocks *a*, they are not sweated on by daubing a coat of solder all over them, as in Figs. 8 and 9, but are held carefully in place after being lapped perfectly flat, and touched with a clean soldering iron as shown at *b b;* no solder being allowed between *a* and *c*.

In making them this way, the method described in connection with Figs. 5, 8 and 9 can be dispensed with. The strips can be planed out carefully on the side *B*, Fig. 6, and *A*, Fig. 7. They can be soldered onto the blocks as shown in different views, either for turning off stock while soft or for grinding the faces true when tempered. The blocks *A*, Fig. 6, must be just right, having one side with angle of 18 degress and the other 15 degrees to





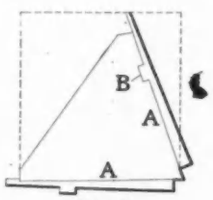


Fig. 5

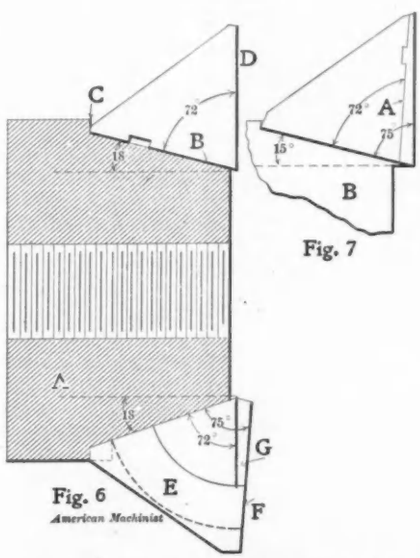


Fig. 7

BLOCK USED IN GRINDING SECTION PIECES.

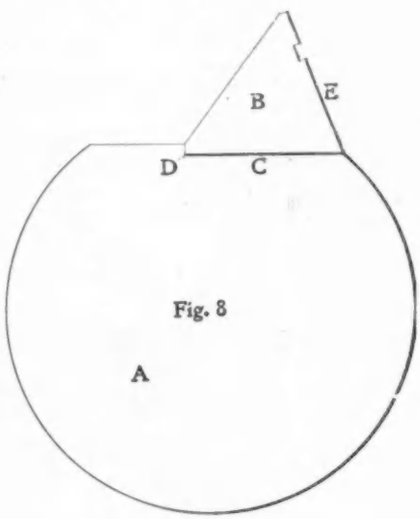


Fig. 8

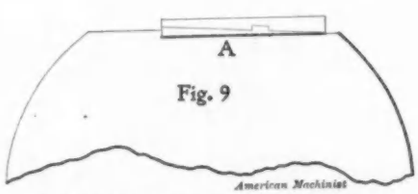
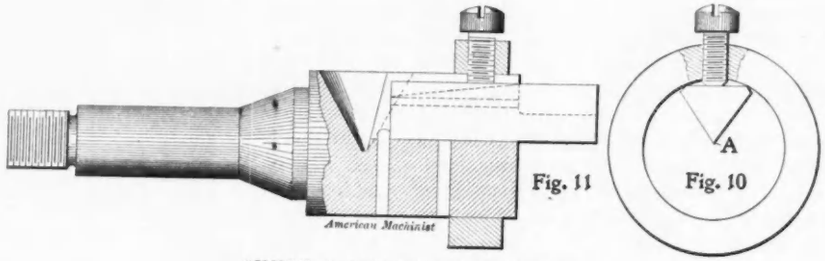


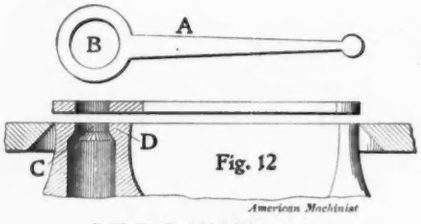
Fig. 9

ARBOR FOR PLANING PIECES.

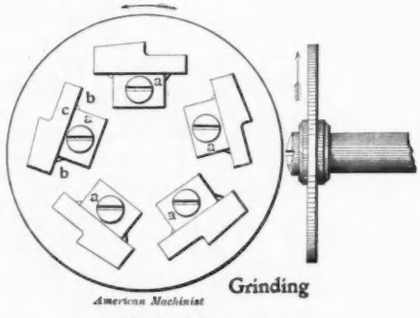
center line of lathe. The face plate to be true and flat, scraped to a smooth surface. The faces of sections *D*, Fig. 6, can be obtained on 18-degree blocks; and Fig 6, on blocks *B*, Fig. 7, in place of using slips; and make the end which does the cutting, or *G*, Fig. 6, on blocks *A*, Fig. 6, or 18 degrees.



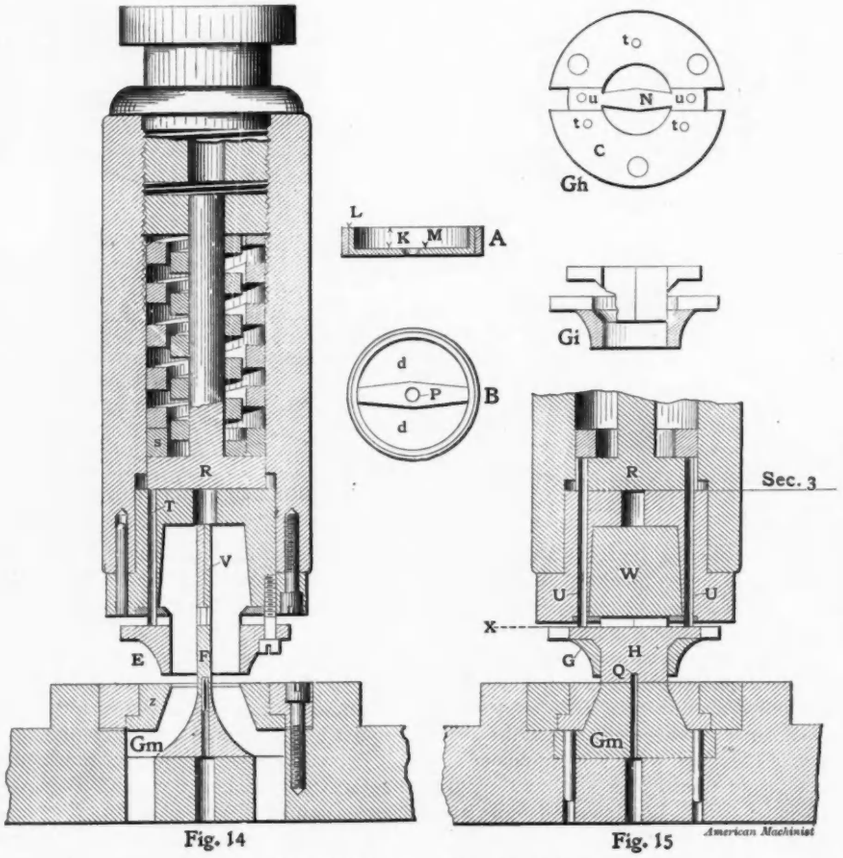
CHUCK FOR TURNING SECTIONS.



DIE FOR REGULATOR.



GRINDING SECTIONS.



SUB-PRESS AND COMPOUND DIE FOR WATCH WORK.

when the slips are soldered into them, making 75 degrees altogether, they can be worked on sides of blocks with 15-degree angle. The same way, if it is desired to use solid sections, grind or cut off face *F*,

In detail of grinding method, the emery wheel is revolving in a direction opposite to that of the work on face plate, and is traversed half way across the face plate and back. When the work is to be ground as shown at *G*, Fig. 6, then the pieces *E*, Fig. 6, must radiate from the center, instead of being placed as shown in detail of grinding method; the small ends to be ground pointing to or from the center of face plate.

Figs. 10 and 11 are two views of chucks showing how the sections are turned and ground off to remove stock before putting into socket *G*, Fig. 3, and finishing to exact size. The chuck is planed or shaped out so that the vertex of 72 degrees angle *A* is at the proper distance from center of chuck.

If not in the right position as to distance from the center, then when the pieces turned separately are grouped together they will not produce a circle on their circumference, but a series of curves. And if the sides of the angle in the chuck are not normal to the radius, or are off to one side of a line drawn through the center, then when a section is put in the chuck, as in Fig. 10, and turned off half its length, and reversed and turned, the same way from the other end, the turnings with tool in one position will cross each other where they meet. This can be remedied by scraping off the angle of the chuck nearest the center, until the turning marks coincide when reversed, and the stock being all removed from one side, the side that was planed keeps the work true. This principle holds good in scraping fits on slide rests, etc., taking all the stock except enough for finish from one side to prevent the loss of rectitude in the work.

The pieces with the slips not yet cut off, as at *J*, Fig. 3, but of the same length as sections, should be forced in, all in a group, into a slightly tapering socket, each end having been turned the last time with lathe tool in one position. Then the back ends should all be turned together and forced into *G*, Fig. 3, though not to the bottom, but against a thin seat or washer. The hub and outside of die are then bored and turned close to size, and hardened and tempered. The variation will be slight in hardening, and the processes described being repeated, the sections and slips are forced to bottom of socket *G*. The latter soldered into a solid chuck with true turning, and the hub and rim of the die ground to exact sizes.

Figs. 14 and 15 are given to show more particularly how two springs can be used to allow for slight variation in a balance wheel when punching the stock away from the arm. *A* shows balance with inside of rim and arm of steel, and outside of rim of brass; *d d* the stock to be punched out. The shedder shown at *C*, *E*, *F*, *G* and *H* is the interesting feature of the die. *G h* is a plan of view at *x*.

Unless the depth *K* was the same in all the balances, a solid shedder would not rest on *L* and *M* at once, and the work would be injured; so *F* in Fig. 14, seen at *H*, Fig. 15, rests on *M* and *E*, or *G*

on *L*. The pins *T*, Fig. 14, would rest on *E*, as shown at dotted circles *t t t* on *G h*.

F, *H* and *N* are free to move up and down in *E*, *G* and *C*, as shown, especially at *G i*. The balance blank is located on pin *Q*, which pin passes through hole *P* in balance blank into clearance hole in *H* when the punching is being done.

The shedder pillar *R* pushes one set of pins like *T*, Fig. 14, and *t t t* in detail, section 3, under the inside spring, and a ring *S* under the outside spring pushes pins like *V*, Fig. 15 (see also *u u*, section 3), and *u u*, Fig. 9 *h*), which pass through *R*. So that *R* works *E* against *L*; while *S* works *F*, *H* or *N* against *M*.

In Fig. 14 and section 3 the slip *V* is put up in halves, and in Fig. 15 is shown solid in section at *W*. *G m*, Figs. 14 and 15, is shown in plan view at detail *G m*.

Speaking of the dowel pins *a a* and *b b*, seen in plan of *V*, Fig. 3, I prefer to leave the rim of the punch as at *c*, free in the sub-press, so that it can be moved the slight distance required to place it in position. The tops of arms *d* are left a little above the piece *z*, Fig. 14, and are filed a little beveling to enter the die, and after being used to locate the web *G m*, the latter is screwed down and the dowel pins *a a* put in. Then the tops of arms are filed off even with *z*, and shaved a little and cut a little with cold chisel until fitted to spaces in die between *h h* section 2. Then it is hardened and tempered, and if found to crowd into the die, is fitted carefully with *G m* and *z*, perfectly free, screwed into place, and new pins put in at *b b*, plan of *V*, Fig. 3.

Chicago, Ill.

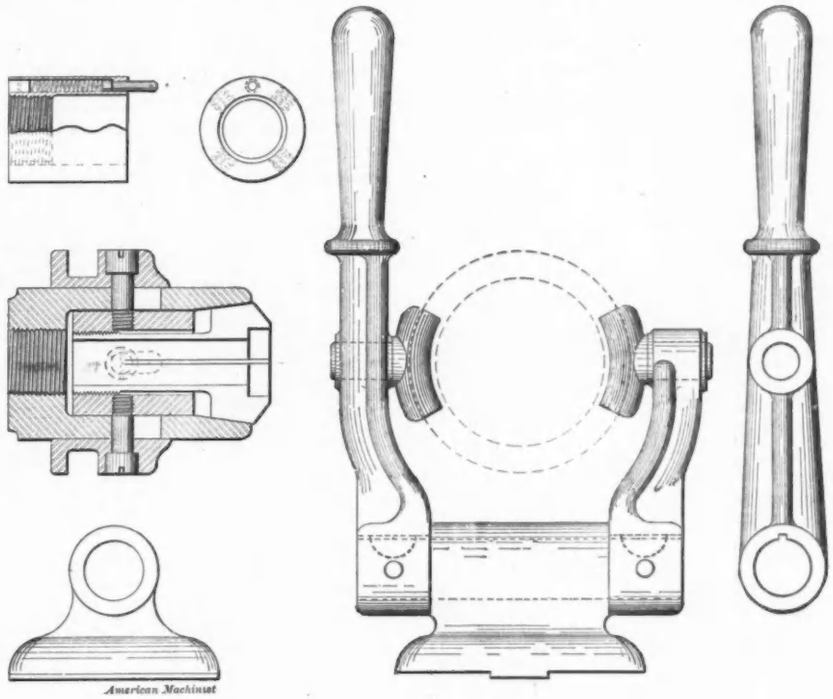
▲ ▲ ▲

A New Bicycle Ball-Case Grinder.

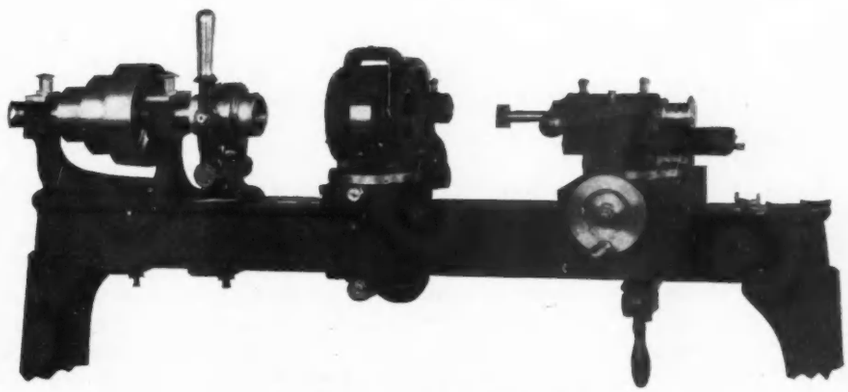
The rate of development of machinery for bicycle manufacture has far outstripped that of the bicycle itself, and an instance of this fact is in the machine herewith illustrated. This machine has been on the market several years, has been successively improved, and has already appeared in our columns.

In the old machine, the cups and cones were held in a three-jawed chuck which was slow to operate. In the present machine, which is called the '97 pattern, one movement of a lever serves to tighten or loosen the chuck as desired. The revolving head in the middle of the bed has a specially designed chuck which will hold the hubs to be ground either by the barrel or by the flange. If but one emery wheel is used, and but one bearing is ground at a time, the head is swiveled half way round for grinding the other end. This revolving head is now driven by a friction wheel, instead of an additional belt as formerly. The friction wheel is at the back, and is caused to engage by the lever in front, which operates a cam wheel. The slide rest for the emery wheel was formerly fixed, and the spindle was made to move in and out, exposing a part of each journal to the emery dust. In the present machine, the rest itself moves by rack and pinion upon protected slides. Both the emery-wheel spindle and the revolving head are equipped with ball bearings. Fig. 2 shows the details of the draw-back chuck and the ball-bearing construction.

This grinder is made by the Diamond Machine Co., Providence, R. I.



DRAW BACK CHUCK.



A NEW BALL-CASE GRINDER.

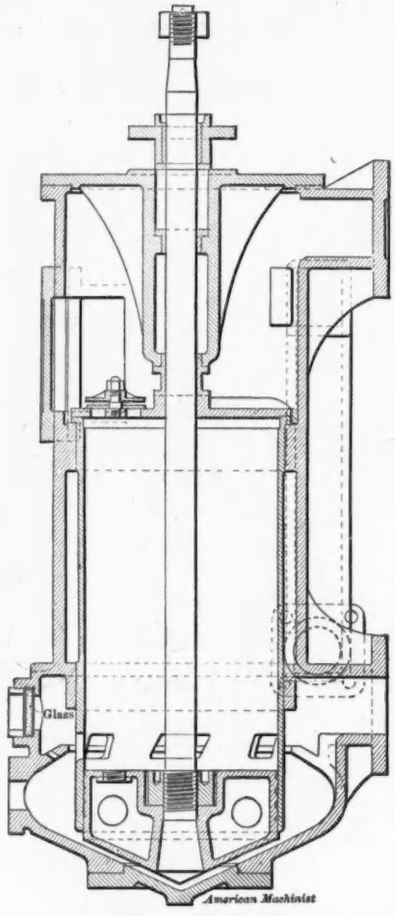
Condenser Air Pump Without Foot or Bucket Valves.

We illustrate herewith an exceedingly ingenious condenser air pump, the design of Mr. Frederick Edwards, and originally described in "Engineering," from which we take our illustration.

The action of the pump is not entirely clear at first glance, and hence we will describe it in detail. Imagine the piston or bucket to be at the top of the barrel. On its descent, the discharge valves at the top will close, resulting in the formation of a vacuum above the bucket. Meanwhile the water will have accumulated in the space *a* with the air above it. As the bucket passes the openings in the side of the barrel, the air will rush in and fill the space above the bucket. Finally, the conical bottom of the bucket will strike the water, and by means of the deflecting plate *b* will throw it through the openings into the interior of the barrel, where it will be caught by the bucket which ascends before the water has time to flow back. Finally, the air and water will be discharged together on the up-stroke as usual.

It will be seen that not only are the port valves done away with, but that the air from the condenser is given an absolutely free entry into the barrel of the pump, instead of, as usual, being obliged to force its way through water-sealed foot valves. As it is primarily the removal of the air which determines the perfection of

the vacuum, this feature is claimed to be an advantage—in fact, it was primarily to secure this that the pump was designed. Mr. Edwards' contention is that the ordinary pump, though in name an air pump, is in construction a water pump, while he has attempted to design an apparatus in which the removal of the air shall be the first consideration.



EDWARDS' AIR PUMP.

This pump is the outgrowth of researches made by Dr. A. B. W. Kennedy, assisted by Mr. Edwards, for the Institution of Mechanical Engineers. It has been subjected to tests which are stated to have been highly satisfactory. No particulars are given, although they are promised at an early date.

▲ ▲ ▲

American Lathes in Buenos Ayres.

Editor American Machinist:

I wish you could let your readers know that to day there is not an American-made lathe in this market for sale. The only one that was here, the firm who had it for sale put it in their own shop, as it was the best tool they had. They use that and push English, French and Dutch. If I could get catalogs of tools, it might be I could do them some good in my position.

CHARLES A. HOWE,
Consulting M. E.
Gen'l Delivery, Buenos Ayres.

Gas-Heating Machines.

The definition of "machine" being, "Any instrument or organization by which power is applied and made effective, or a desired effect is produced," then an instrument or organization by which heat "is applied and made effective," and a "desired effect is produced" with the accuracy and precision of a machine, may properly be called a "heating machine," to distinguish it from ordinary forge fires, furnaces and kilns, which produce a desired heat effect only by careful and skillful handling.

While the use of "gas-heating machines" is yet in its infancy, their utility has been amply demonstrated, and in many kinds of mechanical work requiring systematic application of heat decided advantages have resulted from their introduction, and especially so in a great variety of the manufactures of steel. The simpler forms of heating machines are the gas furnaces, ovens, forge fires and muffle furnaces which have had occasional attention in this journal, while at least two of the illustrations of this article typify a class of such heating devices to which the designation "machine" is obviously appropriate, because it is the combination of the furnace and machinery which produces the desired effect upon the work.

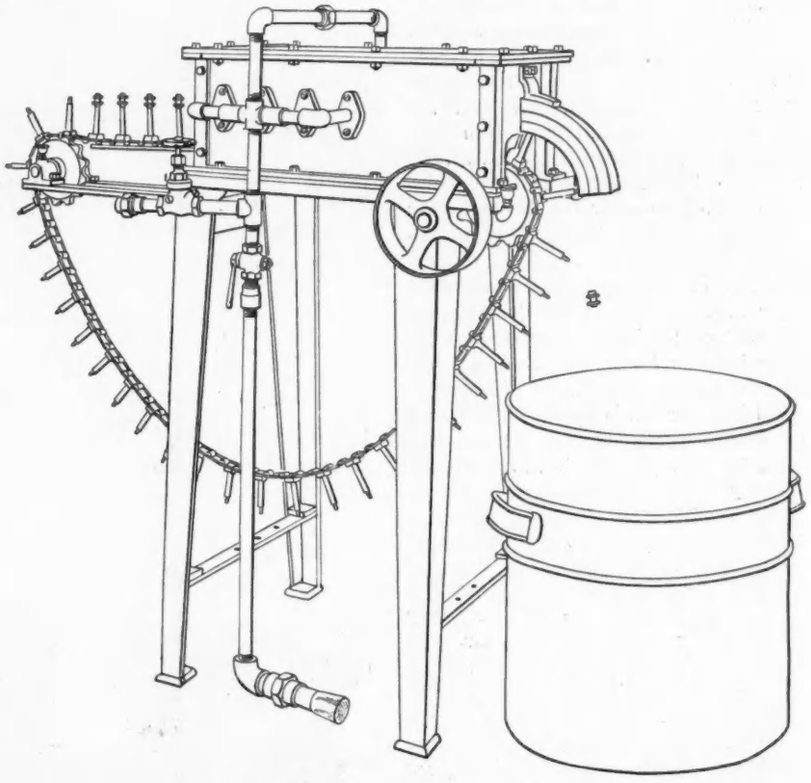


Fig. 1. FURNACE FOR HEATING SMALL ARTICLES.

Fig. 1 shows a heating machine for hardening bicycle cones, shells, or any other small steel work which can be placed on the pins to be carried through the heating chamber. Where the machine is to be used only for one and the same size and kind of work, the pulley which drives the endless chain may be belted from a driving pulley, transmitting the proper speed, which, in this case, is first ascertained by moving the chain experimentally by hand; but owing to the probable variation in the speed of the driving shaft, it is best to connect the chain-drive with a countershaft with cone friction pulleys, which enables the operator to vary the speed of the chain at will and to adjust it to the exact requirements of the work.

To get the desired and uniform heat effect, the supply of gas and air is accurately adjusted by the valves, so that the work which is stuck on the pins, just before they enter the heating chamber, cannot be overheated. The exposure to the heat of the chamber must be long enough to thoroughly penetrate the articles without overheating the finest or thinnest edge, pin, rim or other projection. The degree of heat to be applied is limited usually to a cherry or bright cherry red, and the speed of the chain must therefore be so regulated as to carry articles through the heating chamber into the cooling bath as soon as properly heated.

The construction of such furnaces depends primarily upon the size, shape and weight of the largest article to be treated. By this the length of the heating chamber, and the speed at which the chain is to run, are determined.

With steel work having no small projections, thin points, rims or edges, the temperature in the furnace may be raised so as to do the work quickly. For light shells and work with fine projections,

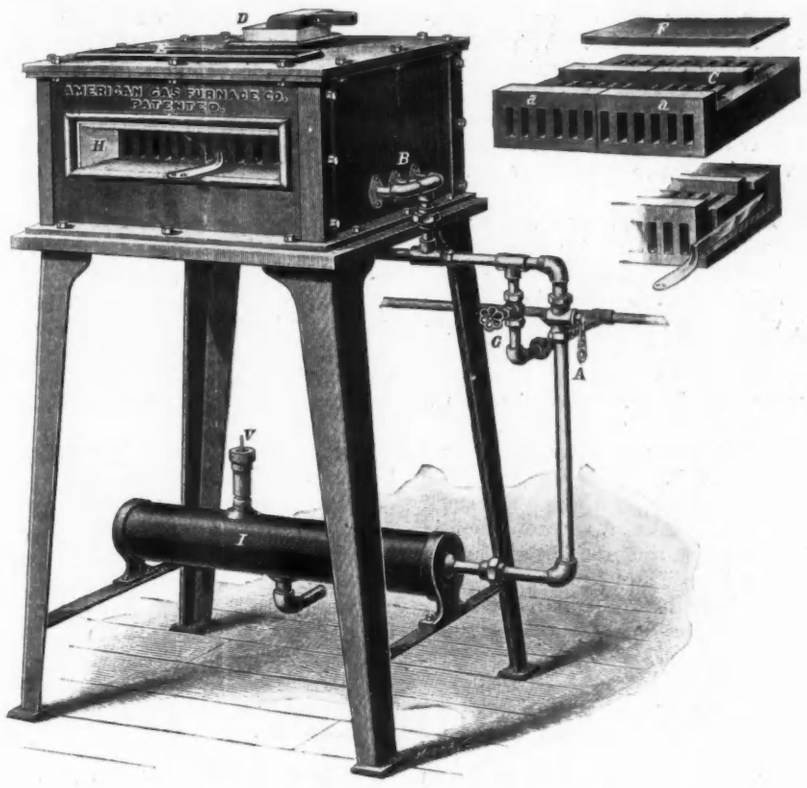


Fig. 2. FURNACE FOR SHEAR BLADES.

receiving the heat more quickly than heavier bodies, the heat is toned down, and under no circumstances must it reach a temperature which could injure the steel. The speed of the chain being properly regulated, the machine will do a considerable variety of work, differing in weight or shape.

Where a large quantity of work is to be done, all of the same kind and weight, the heat and speed of the chain being once adjusted, the output will not only be perfectly uniform in character, but also very large in amount compared with the usual methods.

It will readily be seen that the features embodied in this particular heating machine can be utilized in constructing machines for a great variety of work, and a machine for hardening mower blades has produced excellent results. Mower blades are heated only on the cutting edges, while the body of the blade remains soft. The body of the blade is inserted between clamp-jaws, conforming to it in shape, but leaving the cutting edge of the blade exposed. These jaws are hinged to the chain in place of the pins shown in Fig. 1, and are so arranged that they close, as they enter the furnace, upon the blades inserted by the operator, and open to discharge them just above the cooling bath. While in transit through the open air outside of the furnace, the jaws are sufficiently cooled before they again enter the furnace to prevent undue heating of the blades by contact with them.

Fig. 2 represents a machine for heating shear and knife blades, and was made for a prominent cutlery firm in Sheffield, England, for heating sheep-shear blades. The blades are inserted separately in the partitions of the cast-iron grate *a*. This grate rests upon the fire-brick slab, raised sufficiently from the furnace bottom to form a combustion chamber, into which the burners enter from opposite sides. The combustion chamber is completely separated from the heating chamber, front and sides, by the slab, which does not extend to the rear wall of the furnace, thus leaving a passage in the rear of the furnace of even width between the edge of the slab and the furnace lining. Through this passage or slot the flame is forced from under the slab supporting the grate into the heating chamber and passes over the grate in even volume towards the vent at the front entrance, the flame thus being reverberatory from front to rear, and evenly distributed over the whole width of the heating chamber.

The thin ends and points of the blades are protected from contact with the flame by the cover *F*, which closes the rear half

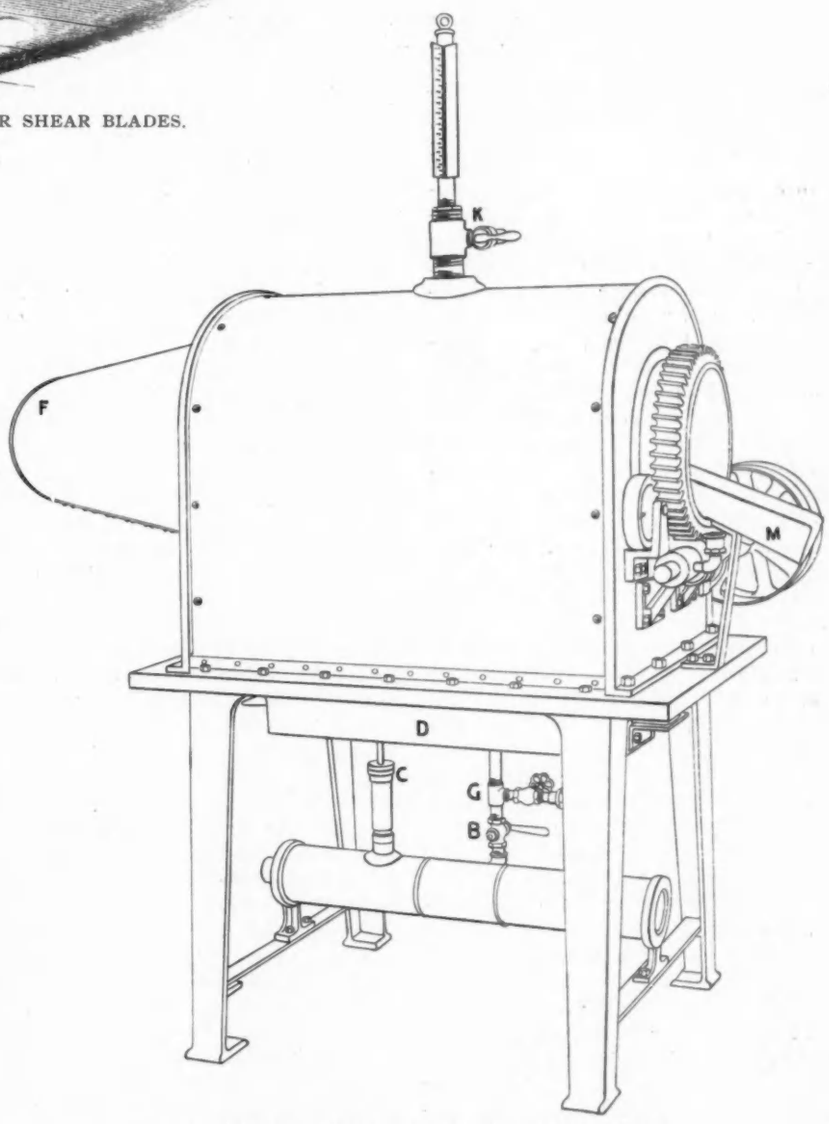


Fig. 3. FURNACE FOR TEMPERING AND COLORING.

of the grate. The heavier portions, at and near the handles, are subjected to this reverberatory sheet of flame, the cover protecting the points and thinner portion of the blade, while the thicker portions receive the direct heat of the flame which enters the open grate partitions and is thence driven forward until it reaches the draft flue at the entrance. The difference in time required to heat the thin and the heavier portions of the blade is thus approximately equalized, so that the whole blade is heated uniformly in practically the same time; the thinnest part of the blade—as will be seen—is heated by conduction, while the thicker portions receive direct heat, the overheating of the vital portion—*i. e.*, the thin edge and point—is thoroughly guarded against.

The degree of heat and the nature of the flame are under perfect control by the gas and air valves. The even distribution of the heat is assured by the furnace itself, and the pressure generated in the heating chamber expels and excludes the outer air, while the flame contains an excess of carbon and is non-oxidizing. With ordinary care, the heat cannot at any time exceed the exact degree required, and is steadily maintained for any length of time without any other trouble than a slight turning of the valve handles to diminish or increase the temperature.

At Fig. 3 is shown a tempering or coloring machine. This is for tempering or coloring small steel articles in large quantitles. The work is placed in the hopper, which feeds it in measured quantities. At every revolution of the hopper a uniform quantity falls into the end opening of a spiral way, contained within a revolving cylinder, which is perforated, and is inclosed by an outer cylinder revolving with it, containing sand. The articles are propelled through the spiral way to the outlet at *M*, and continuously subjected to the action of hot sand sifted upon them until discharged. The temperature is regulated, with reference to the thermometer, to the exact degree required for various tempers or colors, and there are four different means of controlling the heat, viz., by the burner *D* under control of the gas and air valves *G* and *B*, the air pressure by the valve *C*, the vent cock *K*, and the speed at which the revolver is run. It is thus an easy matter to ascertain the exact degree of heat needed for the desired result. As now in use, the revolver is rotated three times per minute, and the heat is regulated by the burner almost exclusively. Where the articles to be treated are frequently changed, and differ in weight and size, the speed should be capable of easy regulation by conical friction pulleys instead of a plain countershaft.

The furnace is in use for pens, penholders, bicycle chain links, and has done excellent work of other kinds, the exact color and temper being attained easily with large quantities, and of perfect uniformity. The machines are made by the American Gas Furnace Co., 80 Nassau street, New York.

ELECTRICAL MACHINERY.

Liberality of Mind Among Electrical Engineers.

BY R. D. WILLIAMS.

In a recent conversation with the mechanical superintendent of one of our leading electrical manufacturing companies, the statement was made that electrical engineers were among the most narrow-minded class of men in the world. This gentleman had left a purely mechanical industry to take his present position, and had had an exceptional opportunity for comparing and contrasting the spirit prevailing among mechanical and electrical men. He mentioned, as a conspicuous illustration of liberality, the articles on bicycle construction which have appeared in your columns, which have been practically an interchange of experience between the leading bicycle factories of this country.

Of course, some spirit of privacy and illiberality is to be found in all industries, and to this the business of machine building is no exception. It is frequently met in efforts to obtain desirable matter for publiction, by all the technical press, and it would be foolish to deny its existence. To a certain degree this can be understood, and to that extent it cannot be complained of. A concern which is obtaining a distinct advantage from some process of its own, cannot be blamed for desiring to keep it from its competitors, although it is usually true that great exaggeration characterizes the estimate placed on the importance of that line of action, which, it should be said, is much more prevalent among men connected with the business side of affairs than among those connected with the mechanical side. Mechanical men, as a rule, recognize that in the game of give-and-take each one acquires far more than he "gives away," and act accordingly; but electrical men appear to have no such spirit. Each one seems to think that his own little notebook contains the final kernel of truth, which it would be suicidal to disclose, and he keeps it carefully hid in his closet. Not only is this spirit manifested as regards the public at large, and between rival corporations, but between individuals, even when employed in the same shop. Each man is largely compelled to work out his own problems, unaided by advice or help from others. The gentleman already referred to, coming from a purely mechanical industry, had at the start but little knowledge of electrical matters; but, although placed in a leading position, he found a great amount of difficulty in acquiring the knowledge which he needed from his own associates. A spirit of jealousy showed itself at once, in consequence of which he was compelled to pick up his information in scraps and by hard knocks.

This is, of course, but a single individual's experience, but corroborative evidence is not wanting, and my observations convince me that the broad statement made has a substantial foundation of truth. A comparison of your own columns with those of the various electrical journals affords evidence of a very conclusive kind. The department of "Letters from Practical Men" is a standing illustration of the spirit which prevails among your constituency. Hints and experience of great value are here given from week to week, "without money and without price," and purely in a spirit of mutual helpfulness. An examination of the files of the electrical journals will show that your columns contain four times as many letters of this type as all of them put together. In the rapid development of the applications of electricity, new problems have arisen in rapid succession, and there is no existing field which would seem to offer as many suggestions for communications of this kind as this, or which would promise to develop as much literature of this kind, provided the spirit which prompts such writing prevails. In point of fact, such literature scarcely exists at all—a fact which I can only attribute to the absence of the spirit necessary to produce it.

There is probably no branch of industry which contains so large a proportion of technically educated men as the electrical. For some years the schools of electrical engineering have been turning them out in large numbers. The demand for such men came with great suddenness, and this, together with the attractiveness of the work, and the fact that it seemed to offer a means of skipping the grimy period which many mechanical engineers have to go through, caused these schools to become very popular at once.

Education is supposed to have a broadening effect on the mind; in fact, in the eye of many educators this is its chief aim and purpose. What sort of evidence in support of this proposition does the condition of the electrical industry give? The great majority of leading mechanical men have come up from the ranks, and, whether that condition continues for the future or not, the present spirit of mutual helpfulness which characterizes mechanical men was established by those of little or no formal education. The spirit which characterizes the electrical industry was, on the con-

trary, established by educated men, and the contrast is not one of which education can be proud.

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A Few Points in Relation to the Construction of Commutators.

BY F. J. TURNER.

II—Large Commutators.

The type of commutator shown in the previous article will answer very well for small sizes, say eight or nine inches in diameter or less; but for large machines it would not be sufficiently reliable. Although, as shown in the foregoing, it is possible to so proportion the insulation that every part will be pressed up solid, we cannot always depend upon it being so at every point. With small diameters there would not be much, if any, danger of a section dropping down, as shown in Fig. 3, because the outside edge is considerably wider than the inner one. But with a large diameter the sides of the sections are more nearly parallel, and if one is unsupported underneath, and not held tight enough between the adjoining sections, it can drop, and cause considerable trouble thereby. To avoid this, the shape of section shown in Fig. 4 is very commonly used. The advantage of this shape is that the insulation *H* will tighten up with an amount of movement of the tightening ring that would produce a very slight effect on *K;* that is, if the insulation between the sections had been pressed up about as far as it would go. With this style of construction it is not at all necessary to have the insulation *K* thick enough to receive the downward pressure of the sections, as *H* holds them from dropping in and *G* from flying out. It will be easily seen that with this construction a solid support for the sections is insured with far less accuracy in the proportions of the various parts of the insulation. In some cases the ends of the sections are made with the beveled part cut inward, as shown by the dotted lines *I, J*. The action is the same in both cases, and will give as solid a construction as the other.

If a commutator is not substantially constructed it will give any amount of trouble when in use, because the sections will be seen to get loose and either drop below the surface or rise above it, and thus cause the brushes to spark badly—so much so, sometimes, as to short-circuit the armature and burn out a coil or more.

It often happens that a well-constructed commutator gives trouble simply because the insulation between the sections is not of the proper thickness. If it is too thin, there is danger of short-circuiting two sections, and thereby burning out an armature coil. This, however, is a very uncommon difficulty. As a rule, the short-circuiting of commutator sections is caused by excessive sparking due to imperfect proportioning of other parts of the machine.

The most common mistake of inexperienced designers is to make the insulation between the sections too thick. When this is done, the brushes will spark, even if the machine is properly proportioned in every other respect. The reason for this is that the mica does not wear away as fast as the copper after it reaches a certain thickness; as a result, the mica soon projects a little above the surface of the metal. The difference may be too small to be measureable, but it will be enough to produce an imperfect contact between the brush and the commutator section. In consequence of this imperfect contact, heat will be generated, which will

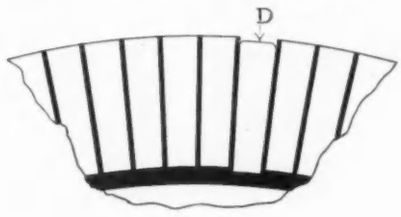

Fig. 3

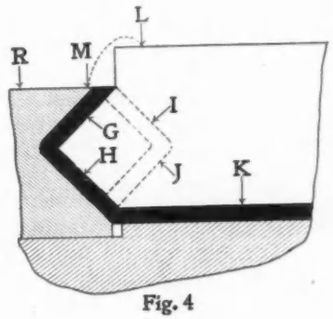

Fig. 4

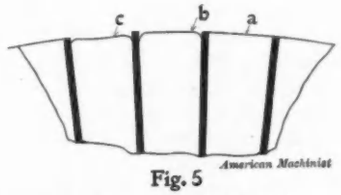

Fig. 5

ARMATURE CONSTRUCTION.

soon corrode the metal and cause microscopic sparks, which in turn will burn away the surface of the sections, thus causing the insulation to project still further. This action is shown, much exaggerated, in Fig. 5, in which *a* shows the smooth surface before the sparking has commenced, and *b* shows where the action begins, while *c* shows the ultimate result if the sparking is not subdued. The sparking commences at *b*, for the reason that when the brush leaves the section *a* and rises up on the insulation, the two nearest metal contacts are the corners of the adjoining sections. As the brush just barely touches these points, sparking will take place with a resulting burning away of the metal, thus rounding off the corners. If the action is allowed to continue, the points where the sparks will pass will advance toward the center of the surface of the sections, because, as the metal next to the insulation is burned away, the points nearest to the brush will move ahead. If the commutator is smoothed off with sandpaper the sparking will stop. This is simply because the sandpaper will cut the mica away so that it will be even with the surface of the metal. After a few days' running the sparking will again commence, and grow worse day by day, until the commutator is again smoothed off. Whenever a commutator acts this way it may safely be assumed that the insulation between the sections is too thick.

It must not be supposed, from the above, that the thickness of the insulation between the sections of a commutator cannot deviate very much from a certain point without causing trouble, for such is not the case. The thickness may vary between two and four hundredths of an inch without causing trouble. If it is less than two hundredths, short-circuiting would become liable, and, in fact, two hundredths should only be used on machines intended for two hundred and thirty volts or less. A thickness of five hundredths may be used, but it is liable to cause sparking. Anything over five hundredths is almost sure to give trouble. An insulation four hundredths of an inch thick is enough for a machine of any voltage used in practice, providing there is no tendency to spark, through imperfect proportions in other parts.

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Letters from Practical Men.

The "Manufacturing Machine Shop."

Editor American Machinist:

Having designed the buildings and most of the special tools, in fact, laid out the entire plant of the "manufacturing machine shop," I would like to draw attention to a few points in the construction of the buildings and tools which may be of interest.

You mention in your editorial that "For heavy work some provision would have to be made for traveling cranes, which were not required in this shop, and consequently were not provided for;" this was so. With cranes, of course, no shafting could be so placed. Traveling cranes can, however, be easily provided for, especially if iron is the material used. The writer has now a building of this class under consideration, in which traveling cranes are to be used, the crane running on the bottom flange of the gutter, so that the crane is almost entirely in the roof. If it is eventually decided to drive each tool with individual motors, no shafting, or very little, will be used; but if line shafting is used, it will be placed under the floor, directly under and in line with the gutters, the countershafts being fastened to bottom of gutter. This arrangement takes all belting entirely out of the way of the cranes. The location of line shafting

in the De Laval shops is such that it is well out of the way, and there is at the same time room for an 8-foot pulley and still have lots of head room.

The safety of the building in case of fire is a most important consideration. This was fully realized by the underwriters, as I was enabled to get a lower rate than any brick-walled building in the city. There is not an inch of the floor that cannot be reached by firemen with their stream of water, from the outside, without ladders or any thing of the kind; and as the floor is not level, but slopes east and west, two men stationed at the north and south entrances can keep the entire floor wet by simply playing the water along the center of the building; and the roof is so constructed that it would burn without falling.

The most desirable things in a factory building are: A strong floor, free from vibration; a good and even light; a water and heat tight roof, and walls sufficient to keep heat in or out. The form of building under consideration has all these qualities.

Only in cases where a special tool would pay for itself in a short time were they put in, and even then they were as far as possible built-up of existing patterns, this being desirable not only from the standpoint of cost, but also time of construction; the whole plant being built and equipped as shown in photographs, and several thousand machines made, in less than two years.

The special No. 6 screw machine has no cut-off slide, as usually put on the Brown & Sharpe screw machine, but a short bed with automatic saddle and cross-slide and flat turret, so that tapers and parallel work can be turned at the same time.

F. HART.

Poughkeepsie, N. Y.

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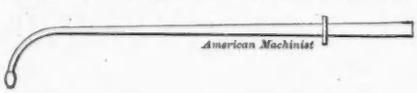
Blow-Pipe Wrinkles.

Editor American Machinist:

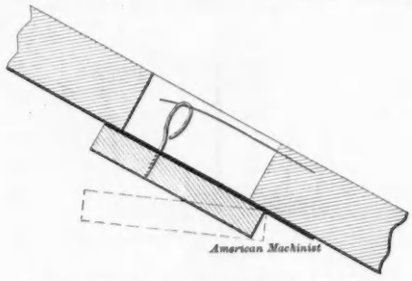
Those of your readers who use the ordinary mouth blow-pipe for soldering, or for hardening small work, probably know what a well-developed habit the mouth end of it has for gathering up dirt from the bench when laid down. Moreover, the verdigris that collects on the



TO KEEP THE MOUTH END CLEAN.

brass doesn't taste quite as nice as quail on toast. Fig. 1 shows how the mouth end can be kept clear of the bench by simply driving or soldering on a disk about 2 inches from the large end. The formation of verdigris where it isn't wanted can be prevented by simply tinning that part with soft solder. Neither of these tricks are original with me.

Besides the mouth blow-pipe, I sometimes have to use a larger one that gets its blast from a foot-bellows. I noticed that in using this, unless I gave my foot a very sudden movement down, the inlet valve wouldn't close, so I took in no air on that stroke. This violent foot motion was not only tiresome, but it wouldn't produce a very regular blast, so I put a small screw-eye part way through the inlet valve, as shown in Fig. 2, and then stuck a piece of fine piano wire into the top board of the bellows, the other end of the wire passing through the screw-eye and relieving the weight of the valve. The valve used to drop down to about the position shown in the dotted lines,



TO CLOSE THE BELLOWS VALVE.

so, even if it closed, part of the air escaped before it did so, and the addition of the screw-eye and spring not only makes it much more pleasant to work with, but also increases the capacity of the bellows to a small extent and makes a steadier blast.

Mr. S. T. Freeland may be interested to know that a device very similar to the one he shows in Fig. 6 in the July 23d issue has been in use some years by an electrical concern, for graduating tangent galvanometers. These instruments, as I recollect them, required a series of graduations of increasing fineness to measure the deflection of the needle. As the strength of the current was proportional to the tangent of the angle of deflection, by dividing a tangent line into equal parts and drawing lines from these divisions to the center, a series of divisions was obtained that made the instrument direct-reading and avoided all reference to a table of tangents.

WALTER GRIBBEN.

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Worthless Patents on Worthless Inventions.

Editor American Machinist:

In a recent issue of your valuable journal you took occasion to discuss the merits of the device of a lathe attachment, patented by D. F. Cornell, of North Fork, Penna., through our firm, and for which we awarded him a prize of $150 on the score of simplicity, wide field for application, etc. We think the strictures passed upon the invention, and especially upon the value of the patent, are unjust and are doubtless based upon a somewhat superficial examination of the device and the principles involved. In justice to our client and ourselves we ask that you will grant us an opportunity to reply to your criticisms.

The chief point made against Mr. Cornell's invention is that his is what is known as a "combination claim," a class of claims to which you attribute little value. With this criticism we must take issue. Anyone familiar with patent law and procedure and the scope of claims knows that a "combination claim" is no more easily avoided than if the same elements were embraced in a claim for the device without being expressed in the form of a combination. A claim for an article in which the same elements are named as in the combination claim would be just as easily avoided by omitting any one of the elements. Suppose the device includes the elements A, B, C and D; it would make no difference in the scope of the claim whether these elements were claimed as a combination or as an article of manufacture. "Almost all inventions at this day that become the subject of patents are the embodiment and adaptation of mechanical appliances that are old. In that consists the invention." (Crandall vs. Walters; 9 F., 659.)

If the rollers in this device had been a new feature they would have been claimed. But it is now well known that there is no invention broadly in supporting any movable object on rollers for the purpose of lessening the friction. It happens that this very idea is quite old—in fact is public property in this very art and is shown in numerous patents. Hence the statement, that "if there is anything new in this device it is the rollers upon which the carriage is supported," is erroneous. It would not take a very violent stretch of the imagination to depict a lathe provided with rollers for the very purpose for which Cornell's rollers are intended; they can be seen in practical use to-day in various parts of the country.

One of the chief objects of Cornell's invention was to dispense with the segmental rack heretofore employed and to substitute therefor bevel gears, one of which is mounted on the shaft of one of the guide rollers. Now, the writer says that the patent can be avoided by dispensing with the bevel pinions, etc., and substituting therefor the rack (the exact device the patentee is endeavoring to get rid of), and thereby avoid any infringement. There never was a patent granted that could not be freed of infringement by such a disjointing, dissecting treatment.

It is employing strong language to say that "mechanically, and as a lathe improvement, the thing is worthless," and we cannot permit such a statement to go uncontradicted. The invention is not worthless; the patent is not worthless. The device is operative, and no attempt has been made to prove to the contrary. No evidence is furnished to show that it is impracticable. No reason has been given to show that for the purpose for which it is intended it is not most efficient. That the construction is new is evidenced

by the granting of the Patent Office after a thorough examination of the records and a careful consideration of all prior patents in the same and analogous arts. "A patent is *prima facie* evidence that the patentee was the inventor of the thing patented, and of its novelty and utility." (Corvallis Fruit Co. vs. Curran; 8 F., 150).

In this connection permit us to quote the following opinion of a learned court in a celebrated patent case (Gould Coupler Co. vs. Pratt *et al.*; Vol. 75 O. G., 1547):

"An invention does not cease to be meritorious because it is simple. The test should not be whether the mechanism is simple or complex, but whether the patentee has given the world something new, whether the public is richer for his contribution to the art; whether he has produced novel and beneficial results. Invention should be determined more by an ascertainment of what the inventor has actually accomplished than by a technical analysis of the means by which the result is attained.

"Where the true value of the invention lies in one element of a combination, and an infringer has appropriated that, he should not be permitted to escape upon the plea that he has omitted a subordinate and comparatively non-essential feature unless it is clear that he has omitted it. To find an invention meritorious and then defeat it by an illiberal construction is as inconsistent as it is unfair. To decide that an inventor has conferred a benefit upon mankind and subsequently destroy his patent by a harsh construction is condemned by the general principles of equity and by express authority. The court should be diligent to give him the rewards of his genius and labor and resolve doubtful points in favor of the patent."

Mr. Cornell's patent is valid and would most certainly be sustained by the courts. His device is simple, novel and effective, and represents an improved method of constructing a common and most useful machine.

A word as to the duty of the patent attorney to advise a client as to the merit of an invention. We have not undertaken to condemn any patentable device. The attorney who, in these days of wonderful discoveries and useful improvements based upon simple inventions, should destroy an inventor's property in an idea by his simple dictum, would assume a responsibility we would shrink from shouldering.

JOHN WEDDERBURN & Co.
Washington, D. C.

[We have given space for the letter printed above because we wished to avoid even the appearance of unfairness or of refusing to allow both sides to be heard. We shall not, however, devote much space to a discussion of it. Our original remarks upon the character and value of the claims in this patent were based upon competent authority and we adhere to them. As to the value of the invention, we should make ourselves ridiculous in the eyes of our readers by stating in detail just why it is worthless. Our readers are mostly machinists—intelligent ones—and understand at sight why the invention is worthless. Any machinist who has ever worked at a real lathe knows just what would happen to those four rollers if an attempt were made to take a cut on such a lathe and it is therefore useless for us to explain the matter.—Ed.]

▲ ▲ ▲

A Sectional Die for Cutting Tempered Steel.

Editor American Machinist:

Some time since a correspondent from Chicago described a sectional die for cutting flat tempered wire. The peculiar advantage claimed was ease of adjustment, whereby the die could be closed as worn and the work cut off with a smooth edge.

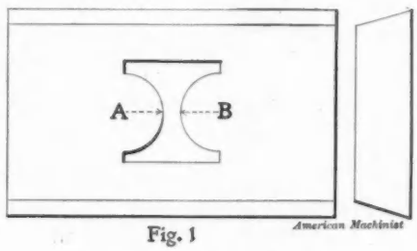


Fig. 1

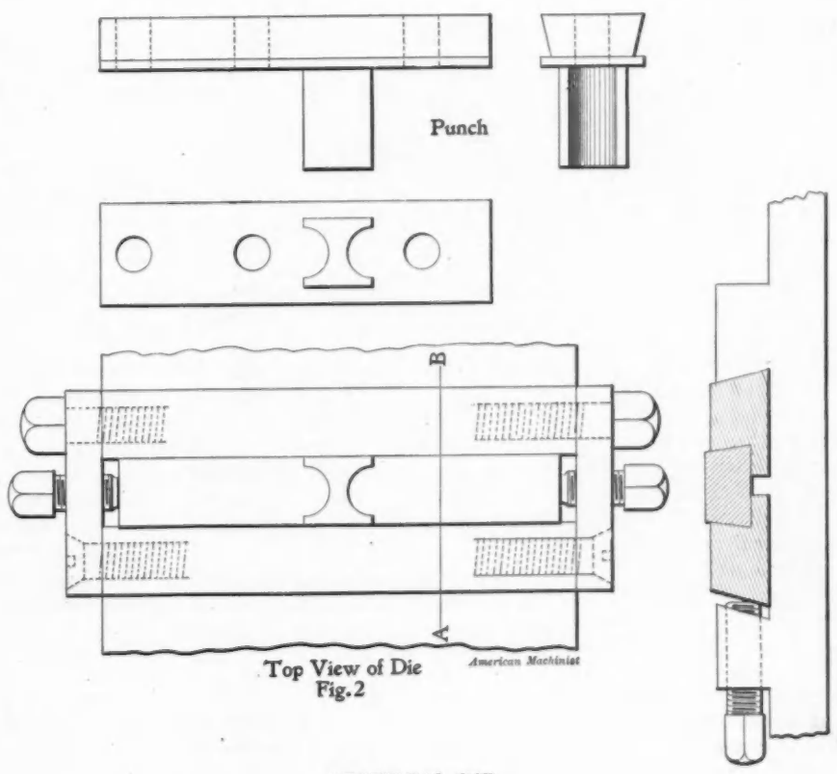
HOLE IN SOLID DIE.

The cutting of spring-tempered flat steel wire is not an easy job at the best, and when the wire is nearly four times as thick, and may be four times as wide, as that cut by the above-mentioned die, and when the ends are cut on the arc of a circle instead of straight across the wire, the operation becomes one that is a source of some anxiety, both to the machine runner and to the die-maker.

In one shop, where the cutting and working of such wire is one of the regular processes of manufacture, the dies formerly used were solid blocks of steel about four inches long, three inches wide and three-fourths of an inch thick. An opening shaped like Fig. 1 was made in the center and the punch fitted to the edges *A* and *B*.

The life of these dies was very short, as the tempered pieces cut out by the punch would wear the hole larger at the top, and the consequent crowding would split the die, and if it had sufficient clearance to avoid this trouble, the frequent grinding necessary to keep the cutting edges sharp, together with the wear, would soon make the punch a loose fit.

Fig. 2 shows how the trouble was overcome and a die made that is satisfactory. The die is in two pieces just alike and about two inches long. These are planed in long pieces cut from the bar of steel, being held in a special fixture on the planer, and are first planed to gage, then cut up and put on the planer in a holder, and the end planed to shape with a forming tool. Clearance is given by the holder, which does not hold the piece exactly perpendicular to the planer table, but at an angle of about one degree. Probably a milling cutter would give better work, but there is none in the shop. The pieces are made interchangeable and only require



Top View of Die
Fig. 2

SECTIONAL DIE.

grinding on the top after hardening, and a little smooth filing on the cutting ends to make them ready for the work.

Straps are put across the ends, each with a set-screw in the center to hold the die sections up to the cut. The ends of the straps are slotted under the binding screws to allow the screws in the press shoe to close the holder onto the die sections and make everything tight. The die is shown without stripper or gages.

The wear on the punches is very slight, as the cut severs the wire and the ends separate enough to clear the punch.

For some work, small punches are set in holes in the block each side of the punch, and holes are made in the die to correspond. Of course, when using these, a part of the adjustability is lost; but the saving in die steel, and the ease with which one piece of the die can be replaced without renewing its mate, show an improvement over the solid die.

The round punches are usually about $\frac{3}{32}$ of an inch in diameter, and will make from ten to fifteen thousand holes before requiring grinding. The punches are oiled slightly with lard oil, put on at irregular intervals by the pressman.

C. E. QUIMBY.

Tilton, N. H.

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The Use of Steel Castings in Press Construction.

Editor American Machinist:

Some years ago I had charge of a press-room on what I then thought to be rather heavy work. It was using plain and compound dies on sheet metal, both brass and iron. Some of the work was very heavy for that class of dies, and we used to break a good many die shoes and bolsters. We used what I call "keyed-in" punches and dies; that is, the punch was held in a slot cut in the lower end of the gate, by a key, and the die was held in the shoe in the same manner—and, by the way, I never have found a better way yet to hold dies firmly when you are using a large number of them—but the combination of the key, a three-pound hammer and a big Dutch die-setter on the handle was too much for the strength of the shoe to stand.

After a good deal of talk I got the superintendent to let me try a few steel ones; they were ordered, the castings came, were finished up and sent into the press room. They stood the racket all right—even the big German and his hammer could make no impression on them. We had used them for a year or more, when we had the misfortune to break the bed, or body castings, of one of our smaller presses, and I took up the fight with the superintendent once more, and it ended in my getting a steel casting to replace the one broken. It took us quite a while to get it. We did not get steel castings in those days as quickly as we do now, and it was a rough casting at that; but we finished it up, got it into place, and it did the work in good shape. We could put a heavy job in the press that would usually have taken a size larger one, and I soon found that the die-setter got into the habit of saving all his heavy jobs for the "steel press."

Things went on in this way for a year or so more, when we had the bad luck to break one of our big presses. It was an arch press weighing about 8,000 pounds, and we were using some very complicated dies in them. There were, if I remember right, some 270 inches of cutting surface in a die less than 24 inches diameter, and we used to punch .025-inch and .040-inch metal on them. It didn't take much of a fight this time to get a steel casting ordered to replace that also. The makers of the press were kind enough to lend us the pattern, and the superintendent had two very heavy ribs put on it after we received it from them, which I thought at the time was a very foolish thing to do. I have changed my mind since then, and have told him so. We got the casting in place, and, I am ashamed to say, made the blunder of not bushing the bearings; *i. e.*, we put a steel shaft into a steel bearing and attempted to run it that way. As a result we got stuck, or at least the shaft did. It made just five revolutions before it seized, and a "deuce of a time" we had to get it out. Well, we got the shaft out and bushed the bearings—there were three of them—got it set up and the dies in it once more, and the difference in the sound of the press from what it was before the breakdown is something that is beyond my ability to put on paper. Formerly I could stand in almost any part of the room and hear the sound of the dies as they struck the metal, whereas it was not now audible over ten feet away, and there was a decided increase in the length of time a die would run after being ground.

Of course, Mr. Editor, I don't expect the press-makers to try to induce their customers to buy steel presses. It is hard enough, as one of them told me, to get customers to buy and pay for cast iron, and they must build what the trade calls for; for if the time ever comes that I start up a press-room of my own—which is a long look ahead—I shall be in the market for some steel castings for a part of the plant at least.

A. P. PRESS.

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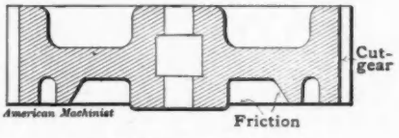
The Dampness or "Temper" of Green Sand.

Editor American Machinist:

After the green sand molder "cuts up" his sand heap, as we say in foundry parlance, it soon becomes of varied temperature from the water gravitating to the bottom, and the action of the air is to dry it out at the top and rear end of the heap. How zealously some molders will sprinkle down that portion that begins to get gray from lack of moisture, while some molders will not be annoyed how the rear end of their heap may be as to dryness or untidiness. There is a veritable wealth of security, or immunity from disappointment and mortification, in that dry end of the molder's sand heap, if judiciously used.

Not long since a certain casting came to a small foundry that required to be exceptionally sound. It had been made at other foundries, in "dry sand;" that is, the mold was baken in an oven. But in this particular foundry there was an absence of necessary conveniences to indulge in such luxuries. The piece was not large but the requirements were. The sketch will give an idea of the shape of the piece.

There were two made in green sand, but when machined, imperfections were disclosed that the customer could not reconcile himself to, either in the friction or on the top of the rim portions of this casting. It being a sample casting, with prospects good for more if these could be made satisfactory, the foundryman wanted to get there, of course. After chewing on the cud of remorse, and of hopes deferred, over a



A DIFFICULT CASTING.

couple of bad ones, an idea came to the foreman, and he carried it out as follows: Instructions were given the molder to prepare some good tempered sea-coal facing sand, fairly heavy; lay on about 2 inches of thickness of facing over the pattern in the nowel or drag, the narrow pocket between rim and friction flange; fill and tuck that and vent it with the facing; then fill the remainder with the driest sand in the rear end of the heap; ram and vent as usual—but less vent is required than if the nowel was filled entirely with all tempered sand.

The molder asked: "What advantage will the dry sand have?"

"When your liquid iron goes into the mold it is of 2,800 degrees temperature. You have in your tempered sand 6.76 per cent. of water. Water is converted into steam at 212 degrees, and steam is condensed into water when it contacts with matter colder than itself. Now, when the water is converted into steam, it attempts to escape. Your dry sand back of the tempered facing will condense this steam, and absorb the water as fast as it is made. Your metal will lie quiet in your mold; no agitation, consequently, no dirt. The result will be what our customer wants—a sound wheel."

Ten were subsequently made under the foregoing *modus operandi*, and every one as sound as if made in dry sand. This method has been tried on a great many pieces since, and it invariably works to perfection. Besides, there is less strain in

evidence on the castings; for with tempered sand entire, the steam cannot be absorbed to the same extent, and the sand yields; while dry sand, backing up the tempered facing as it absorbs the water from the condensed steam, becomes packed harder from the accumulated water.

In a recent test to ascertain the amount of water required in well-tempered sand I found that a box of perfectly dry sand weighed 66½ pounds, and that when properly tempered it weighed 71 pounds, so that the water added was 6.76 per cent. in weight.

L. C. JEWETT.

Boston, Mass.

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A Novel Compound Engine.

We illustrate an engine which may be worth looking at simply as a mechanical curiosity. The half-tone, Fig. 1, shows what would probably be called the back of the engine, with the driving pulley and the valve-operating mechanism. The front of the engine is simply a flat plate or cover the whole size of the engine, and Fig. 2 shows the arrangement and operation of the working parts with the cover removed. To understand the principle upon which the engine acts, no letters of reference are necessary. The bottom or back of the working chamber is flat, and the pistons and connecting rods are assumed to run constantly in contact with this flat surface. The face of the crank disk is also flush with this back flat surface. The front edges of the piston, the connecting rods and the face of the inclosing chamber are also flush with each other, and when the cover is secured in place, no steam can pass either the pistons or the connecting rods to their opposite sides. The "cylinders" at the right and left are rectangular in section, and the "live" steam operates only upon the outer faces of the pistons. The steam valves are at the two upper corners of the engine, and the valves at the lower corners are the exhaust valves. The principal exhaust valve, however, is the crank disk itself, as will be readily seen when the operation of the engine is understood. The slot in the face of the crank disk is always in communication with the atmosphere or condenser.

Noting the position of the parts in Fig. 2, and the direction of revolution as indicated by the arrow on the crank disk, it will be seen that steam has been admitted behind the right-hand piston; it has advanced more than half stroke; the steam valve has closed, and in the present position of the piston it has advanced so far that a passage has been uncovered, indicated by the dotted lines, communicating from this first cylinder to the crank chamber, and the steam, partially expanding as it goes, enters the crank chamber and operates upon one side of the toggle joint formed by the two connecting rods, pressing them downward, and carries the engine over the center. In the position indicated it will be seen that the previous charge of steam has been discharged from the opposite side of the toggle joint through the slot in the crank disk, and the lower sides of the rods have therefore only the atmosphere pressure against them, or, if the engine is connected with a condenser, a more or less perfect vacuum.

When the right-hand piston makes its return stroke, the pressure against the face of it is the same as that in the upper part of the crank chamber, until the communicating passage is closed by the advance of the piston. When this passage is closed, compression begins as soon as the exhaust valve in the lower right-hand corner closes, and the amount of compression is determined by the adjustment of this valve.

The operation of the left-hand end of the engine is similar to that of the right-hand end, that "cylinder" always discharging into the lower part of the crank chamber, while the right-hand cylinder always discharges into the upper part of the same chamber.

A good working model of this engine has been made, Fig. 1 being taken from it. It has been run by steam, and also "by vacuum alone," or with the exhaust pipes connected to the condenser of a large steam engine and the steam passages open to the atmosphere. It will be seen that the engine is essentially, as claimed for it, a compound engine, the "cylinders" at each side being the high-pressure cylinders, and the crank chamber corresponding to and performing the functions of two low-pressure cylinders. The engine has no dead center. Serious difficulties in the way of successful practical operation of this engine will readily suggest themselves, and it is doubtful if it could be made a practical machine, but it is interesting and, we believe, quite novel. The main difficulty, perhaps, would be to keep it steam-tight at the sides of the connecting rods and between them and the disk. It is the invention of Mr. W. C. Kelly, Hastings, Mich.

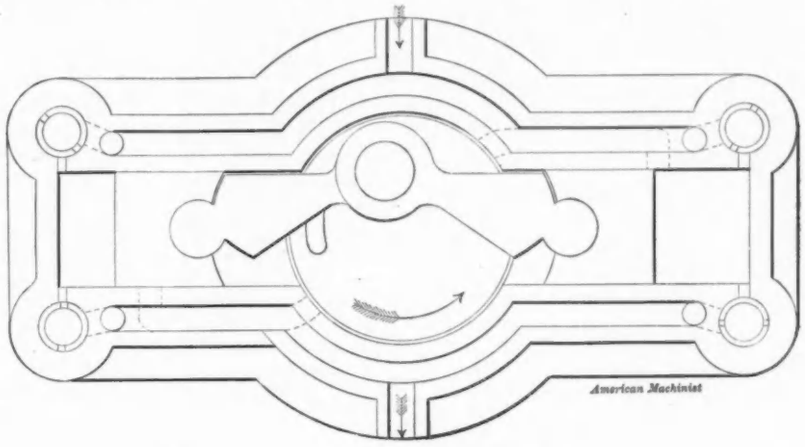

Fig. 2. COVER REMOVED.

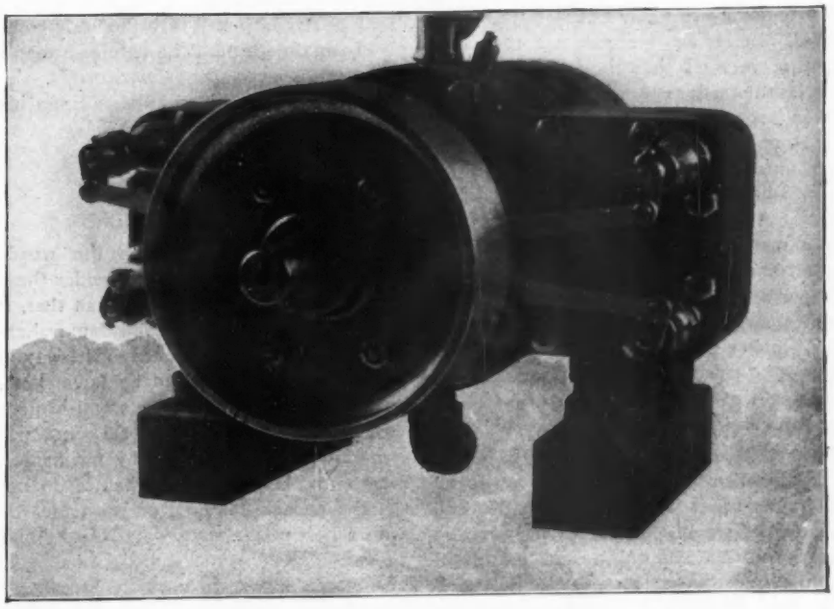

Fig. 1. A NOVEL COMPOUND ENGINE.

The Mechanic's Climacteric.

"Engineering," London, in a recent issue has a thoughful editorial entitled as above. We can attempt only a brief summary of it.

The Amalgamated Society of Engineers (British) have difficulty in finding places for their middle-aged members, while there are not enough young men for the demand. The state of decay begins at forty-five, and after that it is increasingly difficult to get a living.

Both the statement and the conclusions drawn from it are questioned. Large numbers of mechanics remain in steady employment until sixty or more, and other reasons than weight of years may produce the disability. Except for mere muscle work, the middle-aged should be able to hold their own against younger competitors. Experience and knowledge should more than compensate for the burning-out of the fires of youth.

In all ranks and classes of life there is always a large proportion who are unfit, and who do not get along. Their specific incapacities are various. Some are incapable of continuous exertion. They have their periods when they break out. Hobbies of some kind are often a relief and have a great steadying influence with such men. Another form of unfitness is in a tendency to make exasperating mistakes. In an hour sometimes they can spoil more work than the average merely careless man does in a year. Then there is the forgetful man. He is a terror when sent out on a job. He forgets to carry the most essential tools, and when he comes back he leaves something else behind. A love of intrigue is usually fatal to a man's prosperity, especially if in a subordinate position. He cannot give proper attention to his work and he promotes strife all around him. The mischief-maker is never cured, and he should be gotten rid of as soon as possible. An over-sensitiveness, an impatience of control and an inability to live peaceably with one's fellows make a man a nuisance.

Such defects as these cause men to be distrusted and avoided by employers. These defects become more pronounced as the man gets older, and his reputation for them also spreads. The company of middle-aged derelicts is not composed entirely of such as these. Some are physically unable to do a fair day's work, although usually not more than average bodily strength is required. The weak, the diseased and the dissipated fall out early; but the age limit should not be determined from those who, however numerous, must still be regarded as the exceptions. Their position is lamentable, but it is not therefore to be contended that all should be pensioned off at forty-five to fifty. Among the sturdy millwrights of the last generation a man was not deemed to have acquired the "mystery" until he had reached that age, and there were grand old fellows, with gray hair and spectacles, who could carry a job clear through without flinching, and put in a pile of overtime. Our politicians show us that there is no elixir of life like intellectual activity. It is the man who never thinks or plans who fails at forty-five. The "come day, go day, God send Sunday" men wear out much faster than those who put heart and mind into their business. The splendid self-help and self-sacrifice shown by workingmen in their benefit societies command our admiration. But the enforcement of a minimum rate of wages, which is practically a maximum, is a bar to mental exertion, and retards both intellectual and physical development.

To every man, mechanic or not, the climacteric must come sooner or later, but loss of employment is no evidence of it. Employers value reliability. The slow worker, always on time, making a full week, not forgetting what he has to do, never spoiling a job, and never making mischief in the shop, is not lightly discharged. But if for these reasons he is retained when his hair whitens, he must have made his reputation in the years of his maturity. If the weakness of his character has been displayed again and again, if he has been weighed in the balance and found wanting, then very little decay of strength will turn the scale completely against him. The date of a man's climacteric, even of a workman's, depends more upon his mind than upon his body.

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Skilled Labor.

BY F. F. HEMENWAY.

The loose way in which the words "skilled labor" are employed render them utterly without sense; worse than that, it tends to discouragement and demoralization. Reference is had here to the way in which they are employed by lawmakers, writers on economic subjects and in general conversation. True, they are not generally so loosely used by mechanics, who know better; but mechanics do not set the pace in the use of language. It would be just about as sensible to speak of "wet water" as of "skilled labor." As the word "labor" is used in connection with industrial pursuits to describe work to an end, all labor is skilled labor, varying in quality only.

When I was a lad I used to find rather intense satisfaction in watching a woodturner at his work in a small shop—measured by the number of workmen employed—in which were made a variety of wooden articles, including the ancient spinning wheel. The different pieces—parts—of such things as they made were, of course, made in considerable quantities, and eventually assembled, much as would be the practice to-day. A good part of the turning was for purely ornamental purposes; but, unlike probable present practice, no forming tools were used. The turner's tools were his chisels and his eye.

What used to strike me was that this turner—he was amongst the first I had ever seen at the time—would place his pattern on a suitable rest before him, and, with his eye as a measuring instrument of precision, keep, so it seemed to me at the time, an almost constant stream of finished pieces dropping from his lathe, the pieces being so nearly alike that it was impossible to "tell one from the other." It was a boyish amusement of mine to take a dozen of these pieces, indiscriminately, and selecting one, put a mark on it that could be seen only after careful search, then thoroughly mix them together and try and select the one I had marked. I could never accomplish this except by accident. Fearful that it might be my fault, I would get workmen in the shop to make the selection, but could never see that their success was much, if any, better than mine after I had devoted considerable time to the matter.

I ought to remark that one end of one of the pieces that excited my admiration was turned taper for perhaps an inch and a half in length, this tapered end fitting a corresponding tapered hole. To preserve the taper and size of this end, the turner had a piece of iron through which a tapered hole was reamed. Into this he would hastily try about one in fifty of the pieces he was turning.

These pieces were duplicates so far as the instrument used to measure them was concerned—the eye—and the eye is, properly educated and in proper condition, more than the peer of any instrument of precision made by human means.

It has always appeared to me that this turner, who measured these pieces by his eye, did just as creditable a job of measuring as the machinist does who measures and makes alike by the use of the finest measuring instruments.

The pieces of wood were not alike, although a difference could not be detected by the instrument of measurement employed. Neither are the machinist's pieces of metal alike, though they measure alike by human instruments of precision. In either case the skill answers the purpose, though never sufficient; in either case there is room for advancement. The skill of the man who does the one kind of work is not necessarily superior to that of the man who does the other kind, and the skill of the man who digs and fashions ditches may exceed that of either.

As intimated, the word "skilled" is loosely used; it is given a meaning not sanctioned by the dictionary nor by reason, and though the mechanic may be more correct in expression than others, his thought—his reasoning—is influenced by the incorrect practice of others.

It is not necessary to go outside a single trade to find the intention to apply the false meaning—to make the word "skillful" apply to what is done rather than to

how it is done. It will not apply in that way. The machinist who, with the most practical correctness, turns and fits big crank shafts and the heavy machinery of the trade, is hardly considered as being skilled by the one who handles pieces that are weighed by ounces; while the former looks upon the latter as a tinker. And when the law speaks of skilled labor we understand the reference to be to the tools with which a man works rather than to accomplishment. It is all wrong, and its educational influence is bad. All labor is skilled labor, and there is room—stretching away out—for more skill in any kind of labor than is ever applied to it. There is nothing more essential for young men to comprehend than this.

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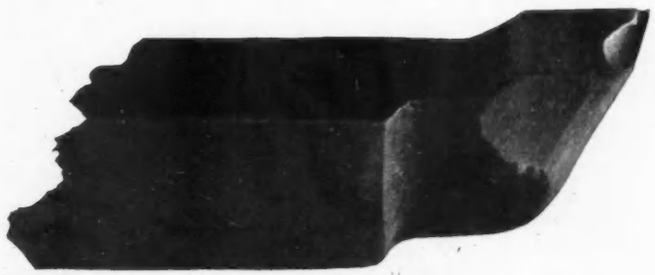
Machine Work in the Yard.

The accompanying half-tone shows how a job was done not long ago in a certain machine shop, or rather, out in the yard. The picture must have a familiar look, especially to some of the old-time machinists. A pulley or fly-wheel, 96 inches diameter by 20-inch face and 6-inch bore, was to be rebored to 7½ inches, and the width of rim was to be cut down to 13 inches.

For boring the pulley a 6 x 6-inch timber was bolted to each side of the pulley against the rim. On each timber was placed a 2½-inch bearing, a boring bar was put through the eye of the pulley and trued up in these bearings by the pulley rim; the bearings were then babbitted. The bar was driven by a belt led through the window from a pulley mounted in a 20-inch lathe. We understand that the pulley stood upright for the boring operation, but we are not told how the bar was fed.

The operation of cutting off the rim speaks for itself. The rim of the pulley was 1⅛ inches thick, and as it had been already turned, the edge served as a guide for the cutting bar. This cutting bar, as will be seen, was simply a timber of sufficient length with a horse at the end of it.



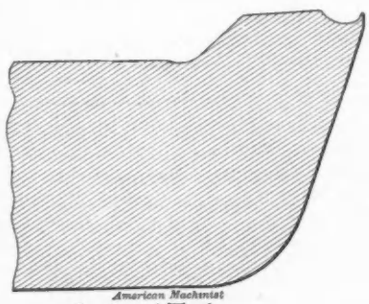
PECULIAR ACTION OF LATHE TOOL.

The tool was fed in a little at each revolution until the rim was cut off. The job, when finished, was as true as if it had been done in an expensive boring mill. The photo was taken in the yard of the Middletown Machine Co., Middletown, O.

Peculiar Action of Tool Steel.

The screw for the Sprague electric elevator is made of high carbon tool steel, and much difficulty was experienced in finding a steel for the tools which would do the work satisfactorily. The steel finally settled upon is an imported German steel, made by Eicken & Co., and its action under the cut is very peculiar. The tool does not get dull in the ordinary way, but continually sharpens itself, the form assumed being shown in our engravings, one of which is from a photograph of a tool after use, while the second is a sketch of this tool intended to show a section perpendicular to the cutting edge. In spite of the wear of the tool, the edge is still keen. There is, however, about a sixteenth of an inch drag on the side toward the work, by which the clearance has been destroyed, and it is to shape up this side of the tool that grinding is necessary.

MACHINE WORK IN THE YARD.



Section of Tool

This action is similar to that of rock drills in certain kinds of sandstone, in which the cutting edges sharpen themselves to an almost razor edge, but we have never seen the action before in lathe tools.

We should add that the tool shown is not at all exceptional, but is a fair representative of a boardful which we recently saw at the works of the Sprague Electric Elevator Co.

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"Scribner's" for September thus summarizes the official and semi-official action which has been taken in the United States upon the metric system: "In 1790, Thomas Jefferson proved that the decimal system would save an unconscionable amount of labor; in the same year Congress decided to wait to see what France would do; in 1820, John Quincy Adams also thought that the metric system was incomparably the best, but decided that it was too much trouble to make a change; in 1866, Congress enacted that if anybody wanted to use the metric system they might do it with impunity. Let up hope that 1896 will bring a decided addition to this meagre record of legislative endeavor."

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The Hyatt roller bearings are being applied to bicycles by the Whitney Mfg. Co., of Hartford, which company offers to put these bearings into any make of wheel, and with it "coast" away from the best ball-bearing wheel made. In point of durability, the rollers certainly have a very great advantage over balls. They are put into barrel hubs, and extend the full length of the hub.

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Fred J. Miller, Editor.

Frank Richards,
F. A. Halsey,
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Prejudice and Mechanical Invention.

Prejudice may be regarded as a good word with a bad reputation. As commonly used it implies something obnoxious, and something which the world would be better without. The world will never be without it, and of necessity it must continually grow in power and in importance. The standing complaint of the inventor and the innovator is that prejudice forever bars his way. While the inventor so complains, the world at large may rejoice at the barrier raised against the ever-threatening tide of change and confusion.

To prejudge is a human necessity. We have to carry much, and we pick up more and more continually, and much time is spent in restowing our load. We are more consistent than we know, and an unconscious process goes on continually of reconciling with each other the things that we know until they fit neatly into each other. If there is no fit, we do not welcome or harbor long the contradictions and the antagonisms that are irreconcilable. The presumption is not for, but all against every new thing, and it must prove its kinship to what has already made its home with us before we can receive it.

It is a fine evidence that we are on the right road when, as the world goes along, prejudice is more and more encountered and complained of by the ignorant man or the pretender, and less and less by the well-informed and the deserving. That something new and good fits well with what we have already, speaks well for the wisdom and correctness of our selections hitherto. Prejudice, so far from repelling, is first of all to welcome novelties that accord with what has been fully accepted.

Prejudice is constantly to be challenged and assaulted, and it is a deed of high renown to make a wide breach in its walls and to carry a new and revolutionary truth into the strongholds of our knowledge. Victory is the test of the truth. Many must still fall outside the breastworks and be buried and forgotten, and as to those who fail, the world is all the better for their failure.

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A Dangerous Engineer.

An example of operative steam engineering as it is too often carried on is to be seen at present at Belmar, N. J., a summer resort on the Atlantic coast below Long Branch. A fishing pier is being built there, and the piles for it are being driven by the hydraulic process, in which water is pumped through a hose to two sections of iron pipe, from the ends of which the water is delivered at such a pressure and in such volume as to wash away the sand and allow the pile to sink by its own weight. For pumping this water, a pump of the Worthington duplex type is used, and there is a boiler of the locomotive type mounted on wheels for the sake of portability. On top of the boiler is a lever safety valve, which, when the writer noticed it, had the weight at the extreme end of the lever, and, in addition, a long, heavy poker hung upon it, reaching nearly to the ground at an angle and partly resting upon the side of the boiler. Upon inquiring of the so-called engineer, we found that unless the poker were in place, the valve would blow off at 100 pounds, which was objectionable. Upon being asked if 100 pounds were not enough to run the pump, the engineer replied: "Oh yes; it will run with 40 pounds for that matter!"

Usually, when safety valves are thus indefinitely and criminally overloaded, the engineer has at least the excuse that more steam pressure is needed for the work than the valve in its normal condition will allow; but here was a man who either could not or would not keep steam within the minimum and maximum pressures with 60 pounds lee-way, and was inviting death for himself and hundreds of nearby residents in cottages and hotels by doing a thing every intelligent engineer knows to be frightfully dangerous, and doing it without even the shadow of an excuse.

What makes such practices all the more dangerous is the familiar fact that a man who will do such a thing is ignorant enough to violate every other rule of practice necessary to secure reasonable safety, and altogether, the conditions present in that case probably make this steam plant about as dangerous as the big guns in the not far-distant proving grounds at Sandy Hook. Indeed, the total energy stored in that boiler, and capable of working destruction, would probably much exceed that exerted by any single discharge of a cannon.

An effective State license law for engineers would seem to be the only real remedy for such a state of affairs. Not long since, a marine engineer employed on a boat plying the waters in the vicinity of New York, was deprived of his license because it was proven that he loaded his safety valve for a greater pressure than that allowed by the inspectors. It would seem as though human life on land were about as valuable as afloat, and is entitled to the same protection.

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As we go to press with this issue, the daily papers announce the death of J. F. Holloway, a mechanical engineer of wide acquaintance and with very many warm friends both in and out of the profession. We will give a more extended notice next week.

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Literary Note.

A COURSE IN MECHANICAL DRAWING. For Evening Schools and Self-Instruction. By Louis Rouillion. The Prang Educational Co. Eighty-six 6x 8 inch pages and 29 full page plates. Price, $1.25.

This is one of the most sensible books on mechanical drawings that we have seen. It begins, as usual, with the representation of geometrical solids and the development of surfaces, and proceeds with machine details. The plates are, obviously, direct photographic reproductions of actual drawings, without the intervention of the engraver, and they hence show what may be done with the pen. The third angle method of projection is taught, as it should be. We can conscientiously recommend the book to anyone desiring to take up the subject.

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Questions and Answers.

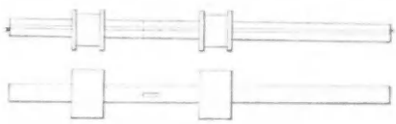
Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(161) C. A. W., Cincinnati, O., asks: Is there any make of fountain pen which can be used successfully with any of the prepared drawing inks now on the market? I use a fountain pen, but it will not write satisfactorily except with thin inks. A.—We do not know of any combination of fountain pen and prepared drawing ink that works for any length of time. If any of our readers have had a happy experience in this line we hope they will let us know.

(162) E. M., Bridgeport, Conn., referring to Question and Answer No. 154, August 27th, says: I cannot clearly understand your answer yet. Will you please to tell me what that 144 is? Probably you

say that it is the number of square inches in a foot. I don't see why the cubic feet are not found without that 144 at all. A.—Our correspondent's perseverance compels our respect and admiration, and we wish that it was far more prevalent. The problem referred to was the computation of the volume of steam used in a certain steam engine under given conditions, and to make it quite clear we might as well begin at the beginning. Say, then, that we have an engine with a square "cylinder" instead of a round one, each side of the square measuring one foot, with a stroke of six inches, and making one revolution per minute. As the complete revolution of the crank would mean two strokes of the piston or one foot of length, the steam consumed, saying nothing about clearance, would be $1 \times 1 \times 1 \times 1 = 1$ cubic foot per minute. If it happened that all our dimensions were in inches instead of feet, it would then be $12 \times 12 \times 12 \times 1 = 1{,}728$ cubic inches, and this divided by 1,728, the number of cubic inches in one cubic foot, would give us 1 cubic foot as before. If we put it into a single operation it would be $12 \times 12 \times 12 \times 1 \div 1{,}728 = 1$, or $12 \times 12 \times 12 \times 1 \div (12 \times 12 \times 12) = 1$. Now, if we put the stroke as a foot instead of 12 inches, and use 1 in place of 12 for the third factor, it is plain that we must also remove 12 as a factor from the division in order to secure the correct result, and we will thus have: $12 \times 12 \times 1 \times 1 \div (12 \times 12 \times 1) = 1$ or $12 \times 12 \times 1 \times 1 \div 144 = 1$. We trust that this will make it clear why we used 144 as a divisor; if it does not, we will try again.

(163) H. Bros., Pa., write us as follows: We expect to get a job, this coming winter, of boring out an old crank-pin hole. The pin is too small, and the party would like to have it larger. The hole is now 3¾ inches at one end and 3¼ inches at the other, which is too much taper. We do not intend to have it more than ¼ inch to the foot taper, or how much would you suggest? How can we bore this taper hole in the crank away from the shop? We expect that we will have to have a taper reamer, but if we could bore it taper it would suit us better. A.—We certainly would not bore it taper. We would bore it straight, build a fire around the crank, and heat it up to a little below a dark-red heat, shrink the pin in and rivet it. It would, however, be quite possible to bore the hole taper, and without much expense. Assuming the engine to be horizontal, turn the crank to the outer center, with the center of the pin hole about the same height as the center of the shaft, and fasten the crank securely above and below the eye so that it will not move during the boring. The thickness of the crank is not given, but we judge that it may be 5 or 6 inches. A boring bar should be provided, say, 4 feet long and 2 inches diameter, turned true, with a good spline the whole length of it and a cutter hole, say, 18 inches from one end and 90 degrees from the center of the spline each way, or crosswise of the bar. Two hubs should then be fitted to the bar with good feathers in them, so that they will slide the whole length of the bar, or, rather, so that when in use the bar will slide through them. These hubs are to be used as journals for the bar, and are to run in fixed bearings to be built up on each side of the crank to be bored. These hubs should be temporarily secured to the bar by a blind set screw, or some other means, and at a distance apart corresponding to the distance of the bearings which they are to run. If the taper determined upon is ¼ inch to the foot, and the bar is 4 feet long, then a new center should be made in each end of the bar and ¼ inch from the original center, one center being in one direction and the other in the opposite direction, but both upon a line parallel to the center of the cutter hole. The bar is to be put in the lathe on these centers, and then the journals should be turned, say, 4 inches diameter and 3 inches long, with the flanges or shoulders to fit each side of the bearing and keep the journals in place as the bar slides through. Bearings are to be provided of hardwood, or of iron, or anything that may be handy, and securely fastened in place at the proper distance on each side of the crank. The bar cannot very well be used for setting the bearings, as it would only be central at one spot and



the ends would be eccentric. A line running through the center of the crank-pin hole and parallel to the shaft would do, or a parallel bar small enough to go through the hole and collars turned true or concentric to fit the bearing. The same bar would do with true collars on it. For doing the boring, the bar may be turned by hand or a pulley may be used. The end of the shaft will, of course, wabble; but if the slack of the belt is on the top, and a pulley of considerable diameter is used, the belt will run all right. A temporary screw should be fixed up to feed the bar along, and a spring at the other end to hold it back, so that the bar will not jump ahead when the cut is light or when the cutter runs into a hole. The spring may be made of a rod of, say, ½-inch round steel bent into a large bow or U, with center points standing out from each arm, one point standing in the center of the bar, and the other against a post or other fixture. With this arrangement there should be no difficulty in boring a good taper hole, and when done it would be no better than a straight one.

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Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 12.

Forming Lathes. Mer. Mach. Tool Co., Meriden, C.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Honest Mach. Oils. F. S. Pease Oil Co., Buffalo, N.Y.

Engine Castings ¼ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Presses and dies for bar and sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Just Issued—Catalog No. 8. Mailed free. Clayton Air Compressor Works, 28 Cortlandt st., New York.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, New Haven, Ct.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

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The Western River Steamboat.*

BY WILLIAM H. BRYAN, ST. LOUIS, MO.

In a public address delivered in 1895 at a convention of engineers, a distinguished speaker made use of the following language:

"The advances in lake marine have been almost as great as those in ocean marine, but all this time our Western rivers are navigated by boats which differ little from those which ran upon them fifty years ago. They still have the wooden hulls, the long-stroke, high-pressure, horizontal engine, the big separate side wheels, and the battery of small boilers; their machinery is a little better than it was at first, the pressure they carry a little higher, but the changes are so slight as to be insignificant. The channels of the principal Western rivers are being constantly improved under the direction of the general government, but as yet no response has been made to these improvements by the radical improvements which ought to come in the boats and their engines. Much is said of the decline of river business; it has declined because land transportation has given better and cheaper facilities. Until the boats on the Western rivers make the same advance that other tools of transportation have made, this business must continue to decline."

I rise to the defence of the Western river steamer. It seems proper that something be said in reply to such criticisms as these.

There are some minor points in which the Western river steamer may be improved, but in its general design and construction it is admirably fitted for the peculiar work which it has to do. Considered, therefore, strictly from an engineering standpoint, it is a creditable structure.

From my earliest days I have been closely associated with river interests—I may almost say I was raised upon the river—having filled every position on board a steamboat from "roustabout" to master. With all due respect to the author of the remarks in question, I am satisfied that they are open to adverse criticism from the standpoint of personal experience and observation.

The critic is mistaken in the implied statement that the construction which he criticises is still universal. There are many iron-hull steamers on the rivers; there are some short-stroke engines driving propellers. In many sections the stern-wheel boats have become more

* Presented at the St. Louis meeting (May, 1896) of the American Society of Mechanical Engineers.

numerous than the side-wheelers. The machinery, while preserving the original characteristics, has undergone many improvements in detail. He also over-estimates the improvements made by the general government. While the situation has been somewhat bettered in places, there has been no great improvement in the low-water channel as a whole—certainly not enough to warrant any radical changes in the construction of the steamers.

He compares the advances which have been made in the ocean and lake marine with those on the Western rivers, very much to the disadvantage of the latter. He overlooks the fact, however, that the conditions of service are radically different, and that these differences necessitate—in fact compel—differences in the character of the machinery. The boilers and engines of the magnificent ocean liners would be as much out of place, and would fare as disastrously, on the Western river steamer, as would the machinery of the latter if transferred to ocean service. Machinery essentially similar to that employed on the lakes has been tried many times on Western river steamers. Hundreds of thousands of dollars have been spent on experiments of this kind, and the result has always been failure. Even the vertical engine has been abandoned. Permit me, therefore, to repeat that—barring unimportant details—the machinery of the Western river steamer is pre-eminently "the right thing in the right place."

The peculiar conditions of service which render necessary the characteristic types of machinery may be stated as follows:

First—The necessity for light draught. For many months of the year—particularly in the upper rivers—the depth of channel is so low that every superfluous pound of weight must be done away with, in order that the boats may be as light draught as possible. This compels the use of machinery which can be worked to the utmost per pound of weight. From this results the necessity of high pressures, single cylinders and few complications.

Second—Bad feed water. The steamers as a rule must use water for their boilers directly from the river, which water—particularly in the Mississippi and Missouri rivers—carries large amounts not only of mineral matter in solution, but of finely divided particles of mud in mechanical suspension, the latter sometimes running as high as one-half of one per cent. by weight. As neither sedimentation, filtration, nor surface condensers are practicable, the boilers must be so constructed as to give satisfactory service with this water fed directly to them. The "battery of small boilers" usually found is, therefore, abundantly justified by the three conditions—getting the maximum work out of a given weight, carrying high pressure, and using bad feed water.

Third—Absolute reliability required. The channels are often narrow and crooked, and steamers must find their way on the darkest nights among shoals and snags and around short bends. The engines must always be under the quick and positive control of the attendant, whether to change speed, stop, or reverse. It has been found that all improvements in the type of machinery necessarily increase the complications of parts, thereby lessening the reliability of operation and increasing the likelihood of accident or derangement.

Fourth—The necessity—common to all water craft—of having the machinery occupy as little space as possible, in order that the remining room may be devoted to the carrying of profitable cargoes, is nowhere more strongly emphasized than in the case of the Western river steamer.

Fifth—Low fuel cost. Improvements in modern machinery are almost wholly in the direction of reducing fuel expenditures. After all, this is a relatively unimportant item, as it usually forms but a small percentage of the total expense of operating the steamer. Fuel can generally be purchased at short intervals along the river, in abundant quantity, of excellent quality, and at a low price. The steamer need only carry enough fuel on board to carry her to the next point of supply.

Sixth—The question of first cost has, when added to the above points, helped to prevent the adoption of higher-priced machinery. The average life of a steamer is so short, the rates of insurance so high, and the period of employment during the season is so limited, as to make it imperative that the investment be kept at minimum.

Experiment has demonstrated that the saving in fuel due to improved machinery does not, as a rule, compensate for the drawbacks accompanying its use, such as increased weight, space occupied, greater first cost and less reliability.

Personally I am an advocate of the use of iron or steel hulls. They are already becoming common on Western rivers, and would be used almost universally if the first cost were not so great. A few years ago the cost was about double that of wooden hulls, but at the present low price of iron I believe the cost would be but little, if any, greater, if built in yards specially equipped with proper tools for the work. They certainly add to the steamer's life and reduce its draught.

Long-stroke engines and side or stern wheels are necessary on account of the low depth of the channel.

Two forms of adjustable cut-offs have been introduced on the standard Poppett-valve engine in recent years with considerable success, the "California" or "Cross," and the "Rees." Instead of the usual fixed cut-off of one-half, five-eighths, or three-fourths, it is adjustable at any point throughout the entire length of stroke. While it is an excellent feature to be able to vary the point of cut-off at will, an early cut-off is not always desirable, as it necessitates larger cylinders, greater weight and first cost to do the same work. Furthermore, the usual flywheel cannot be employed. This drawback is to some extent remedied on stern-wheel steamers where the two engines are coupled at right angles. I see no reason, however, why some substitute for the flywheel—such, for instance, as the Worthington high-duty attachment—could not be employed on side or even stern-wheel steamers, in connection with the adjustable cut-off, to great advantage.

I cannot agree with the critic that the decline of river transportation is due to lack of improvement in the steamers and that the introduction of lake and ocean machinery would rehabilitate river traffic. In my opinion it is due to other easily discernible causes, and the remedy must be found in other directions.

When compound engines have been used on the rivers the engineers soon learned the trick of bleeding a little live steam directly into the low-pressure cylinders, using as much steam this way as the boilers could make. This practice became almost universal, as the loss in fuel was more than made up by the increased speed and the shortening of the time between the terminals, which, on long trips, resulted in a considerable reduction of general expenses.

Even were the condensing engine defensible from other points of view, the adding of, say, twelve pounds to a mean effective pressure of one hundred and twenty-five would usually be a gain so small as not to warrant the expense and complications necessary. On the lower river, however, where there is a deep-water channel for the greater part of the year, compound engines with surface condensers furnishing distilled water for boiler use, and thereby permitting improved types of boilers, might be entirely proper. Fuel is more expensive in this part of the country, and the saving on long runs may warrant the increased space occupied and greater first cost.

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Boiling Temperatures.

There is a little matter connected with boiling materials in closed vessels that demands attention, because it is one that is apt to be overlooked, and yet at times it may be the cause of unsatisfactory results, and that is, the presence of air. Let us assume that something is to be boiled at a few degrees above the boiling point, and that it is placed in a closed vessel for the purpose, and liquid is run in, partially filling the vessel, but leaving a considerable volume of air. Every opening being now closed, and the vessel being heated by direct steam, by fire, or by a steam coil, the proper temperature is adjudged by means of a pressure gage. Assume that the pressure shown by the gage is 5

pounds. The temperature of water boiling at 5 pounds pressure is about 228 degrees, or 16 degrees above the boiling point at a pressure of one atmosphere. But the temperature can only be rightly inferred from the pressure gage when no air is present. At 228 degrees the air in the closed vessel (which we will assume was at 60 degrees when closed up) will have a much higher pressure than 5 pounds, and if, therefore, this pressure has been obtained by rise in temperature of the contained air, we have not a temperature of the water corresponding to 5 pounds pressure, but something considerably less.

As air doubles its volume at zero Fahr. for each additional 459 degrees, the ratio of the volume at 228 degrees and at 60 degreees will be as (459 + 228) is to (459 + 60), or as 687 to 519. At the latter volume the pressure was atmospheric, or, say, 15 pounds. If, then, at the temperature of 228 degrees, the air would expand to 687 volumes at 15 pounds pressure, its pressure when kept within the same closed vessel will be just about 20 pounds. In other words, the pressure will be 5 pounds on the gage, or just equal to that of steam at the same temperature. But take a lower temperature, say 220 degrees: The corresponding air pressure will be still very nearly 20 pounds, or 5 pounds above atmosphere; but the corresponding steam pressure will only be 17 pounds, or 3 pounds above atmosphere, and at lower temperatures it may be inferred that a boiling temperature has been passed simply because the gage shows something over atmospheric pressure. Where the exact attainment of 212 degrees is important, and anything more or less is undesirable, this factor is of importance. The remedy is plain and simple, and consists simply in having means to let the air be blown out as the water gets hotter, and taking care that such means are used. The air is soon expelled when steam begins to form. I have drawn some attention to this point because it really is important at and near the temperature of 212 degrees, and because I have found a tendency to regard it as important at higher temperatures. But it is not of much importance at higher temperatures. Thus, at 400 degrees, air which begins at 60 degrees only attains a pressure of barely 25 pounds, or 10 pounds gage pressure; but water, at 400 degrees, gives off steam at 250 pounds total pressure. Obviously, any air then present has no practical effect, so that the influence of air is limited in range, and must not, because important in certain circumstances, be allowed to exercise undue weight in less refined conditions.

W. H. BOOTH.

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A larger number of American machine builders have visited Europe this summer looking after business than ever before, and the export trade, especially in tools is becoming a very prominent feature of the business.

A Remarkable Clock.

BY W. F. DURFEE.

There has been for centuries past a class of inventors who have wasted their years and squandered their substance in efforts to discover a combination of mechanism which would not only have sufficient power to keep itself in motion, but also have a surplus "to let."

Just when the first notion of a mechanism that would generate power, drive itself and have a surplus of energy for other purposes, originated, it is impossible to state; but we have no evidence of the activity of the idea prior to the thirteenth century, except the remark of Wilars de Honecourt, a French architect of that period, who, in his "Sketch Book," says: "Many a time have skillful workmen tried to contrive a wheel that shall turn of itself: here is a way to make such a one, by means of an uneaven number of mallets, or by quicksilver." From this remark it is evident that perpetual motion enthusiasts were not uncommon six hundred years ago. Honecourt gives a rough sketch of a wheel having five mallets attached to swinging arms, and evidently supposed that three would always be descending and

Fig. 1. PERPETUAL MOTION CLOCK.

two ascending. This sketch is the earliest delineation extant of an attempt at a self-moving mechanism.

A purely mechanical "perpetual motion" must depend for its action upon energy generated within itself, and must not employ any of the natural forces. Such a construction necessarily involves some form of spring-driven mechanism, which will be always in motion, and have at least sufficient inherent energy to keep its actuating spring always wound up. Inventors have never discovered a way to accomplish this, and there is no probability that they ever will; but there has been a number of pseudo-perpetual motions constructed which depended for their action upon the practically constant activity of some natural force—such as the expansion and contraction of bars of metal, or the rise and fall of the mercury in a thermometer tube under the influence of varying atmospheric temperatures, and the rise or fall of the mercury in a barometer in response to the varying atmospheric pressure. But such constructions are not the realization of the idea of mechanical perpetual motion—in fact come no nearer to it than a windmill driven by a constant wind, or a water-mill operated by a perpetually flowing stream.

Among the most remarkable of the mechanisms which have been called "perpetual motions" was the "perpetual motion clock" constructed by Mr. James Cox, a famous jeweler of London, prior to 1773. James Cox was a very able and enterprising mechanician who established a museum in London, mainly consisting of exceedingly ingenious and expensive automata, which was probably the most wonderful collection of such mechanism ever brought together. Some idea of the value and rarity of the exhibits may be inferred from the price of admission, which was one guinea ($5), and also from the fact that in the year 1773 the English Parliament honored Mr. Cox by passing a special act authorizing him to dispose of his unique collection by a lottery in which the aggregate value of the principal prizes was fixed at £134,500 ($672,500).

The forty-seventh item in this remarkable lottery of automata was the "perpetual motion clock," which was described by Mr. Cox as follows:

"The perpetual motion is a mechanical and philosophical time-piece, which, after great labor, numberless trials, unwearied attention and immense expense, is at length brought to perfection. From this piece, by an union of the mechanic and philosophic principles, a motion is obtained that will continue forever; and although the metals of steel and brass, of which it is constructed, must in time decay (a fate to which even *the great globe itself, yea, all that it inherits are exposed*), still, the primary cause of its motion being constant, and the friction upon every part extremely insignificant, it will continue in action for a longer duration than any mechanical performance has ever been known to do.

"This extraordinary piece is something above the height, size and dimensions of a common eight-day pendulum clock; the case is of mahogany, in the architectural style, with columns and pilasters, cornices and mouldings, of brass, finely wrought,

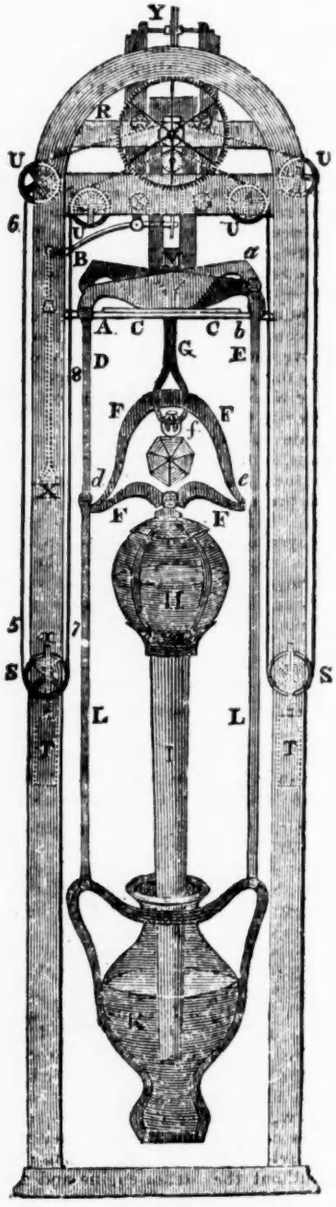

Fig. 2. DETAILS OF CLOCK.

richly gilt, and improved with the most elegantly adapted ornaments. It is glazed on every side, whereby its construction, the mode of its performance, and the masterly execution of the workmanship, may be discovered by the intelligent spectator. The time-piece is affixed to the part from whence the power is derived; it goes upon diamonds, or (to speak more technically) is *jewelled in every part* where its friction could be lessened; nor will it require any other assistance than the common regulation necessary for any other time-keeper, to make it perform with the utmost exactness. Besides the hour and minute, there is a second hand, always in motion; and to prevent the least idea of deception, as well as to keep out the dust, the whole is enclosed within frames of glass, and will be placed in the center of the museum, for the inspection of every curious observer.

"N. B.—The very existence of motion in the time-piece is originated, continued and pefected from the philosophical principle, by which alone it acts."

Fig. 1 is a perspective elevation of this perpetual motion clock. That it was a remarkable piece of mechanism there can be little doubt. It was examined by the distinguished physicist, James Ferguson, who wrote Mr. Cox the following commendatory letter:

"SIR—I have seen and examined the above-described clock, which is kept constantly going by the rising and falling of the quicksilver in a most extraordinary Barometer; and there is no danger of its ever failing to go, for there is always such a quantity of moving power accumulated as would keep the clock going for a year, even if the Barometer should be quite away from it. And, indeed, on examining the whole contrivance and construction, I must with truth say, that it is the most ingenious piece of mechanism I ever saw in my life.

"JAMES FERGUSON.

"Bolt Court, Fleet Street,

"January 28, 1774."

Fig. 2 is a front elevation of the mechanism of Mr. Cox's clock. "*A*, *a* and *B*, *b* are two strong pieces of metal, curved on the under side, like the rocker of a cradle, to which their motion on the supporting plate *c*, *c* is similar; they are, therefore, distinguished by the name of *cradles*. To the end of the cradle *A* is hung a rod *D*, *d*, and to the opposite end of the other cradle *b* is hung the other rod *E*, *e*. By the lower end of these two rods (which are of equal length), at *d* and *e*, the frame *F*, *F*, *F*, *F* hangs, with the gimbal *f*, and its upright bar *G*. To the middle of the lowest part of this frame is hung the large glass ball or bulb of a barometer *H*; the tube of which, *I*, goes down into the quicksilver in the glass cistern *K*. This cistern is supported by two rods *L*, *L*, whose ends hang from the contrary ends of the cradles *A*, *a* and *B*, *b*; the right-hand rod from the end *a* of the cradle *A*, *a*, and the left-hand rod from the end *B* of the cradle *B*, *b*. A very small degree of attention to this connection will show that if the bulb *H* be pulled down it must draw up the cistern *K*, and if the cistern be pulled down it will draw up the bulb; for as either end of a cradle goes down, the other end must rise. The cistern being open at top, the atmosphere exerts a varying pressure on the surface of the quicksilver, and when heavy, forces the greater part of it up the tube *I*, into the bulb *H*; this makes the bulb heavy and the cistern light; the bulb, therefore, descends, and draws up the cistern. On

the contrary, when the air becomes light, its pressure is so much less on the surface of the quicksilver in the cistern; and being then unable to support the lengthened column of quicksilver in the bulb, part of it descends into the cistern, which, becoming thus heavier than the bulb, descends and draws it up. And thus, when the air is heavy the bulb descends, and ascends when the air is light, through more than double the space that the mercury rises and falls in a common barometer. The frame *F, F, F, F* and its upright *G*, being connected with the bulb, rise and fall with it. To this upright bar *G* is attached the winding-up frame *M*, which is shown on a larger scale in Fig. 3. In this frame are two thin metal plates *m* and *n*, toothed like the blades of saws—one set of teeth, *m*, pointing downwards, and the other set, *n*, pointing upwards. When the frame falls, the teeth of the saw *m*, by means of a sliding movement, engage the teeth of the wheel *N*, and turn it round in the direction shown by the arrow; when the frame rises, the saw *m* is disengaged by the sliding movement, and the saw *n* is brought into connection with the wheel *N*, which it turns round in the same direction as before; so that whether the frame ascends or descends, it is continually turning the wheel *N* in the same direction. This frame moves between four friction wheels, which retain it in an upright position. *O* is a catch which falls into the teeth of the wheel, to keep it from being turned in the contrary direction by any accident during the short interval of time between one of the saws leaving the wheel and the other taking into it. On the back of the wheel *N* is a pulley, with sharp-pointed pins fixed in the bottom of its groove, for laying hold of the endless chain 1, 2. Above this is just such another pulley, over which the chain also goes, 3, 4. This last pulley is fixed on the axis of the great wheel *R* (Fig. 2) of the clock movement, by which the whole of the clock-work is put in motion.

"Returning to Fig. 2—the endless chain just described passes over the four upper pulleys *U, U, U, U*, which are fixed, and under the two lower ones *S* and *s*, which rise and fall with the heavy weight *T* on one side, and the lighter counterpoise *t* on the other side, which hang from the pulley frames. The weights consisted of two boxes made of thin brass plate; but *T* was filled with lead, while *t* was quite empty. The weight *T* acts with half its force of gravity upon the part 5, 6 of the endless chain; and with the other half upon the parts 7, 8 by pulling the former part, it turns round the great wheel *R* as fast as the motion of the balance of the clock will permit that wheel to move. It will be seen that if this motion continued for a short time, the weight *T* would go down to the bottom and then the clock would stop. But the train of the movement is such that the weight would keep the clock going a whole year before it would descend quite to the bottom of the machine. By the above-mentioned contrivance of the wind-up frame *M*, which, as it moves up and down, turns the wheel *N* round (in a direction contrary to that in which the pulley and wheel *R* is moving), and draws up the chain in the direction 7, 8, while the weight *T* is pulling down the part 5, 6, the weight is prevented from ever going down to the bottom, and a perpetual motion is produced in the clock by the alternating pressure of the atmosphere on the barometer *H, I, K*. The weight of quicksilver employed was about one hundred and fifty pounds.

"The only inconvenience that Mr. Cox found in all this machinery was, that the changes of the air affected the barometer so much as to draw up the weight through more space than the clock movement would allow it to descend, which tended to overwind the clock and break the chain. To remedy this, Mr. Cox made the wind-up wheel to turn loose on the arbor whenever a click was discharged from its rachet wheel. And although the action of the wind-up frame, etc., would continue, they would have no effect upon the chain pulley and arbor, which would remain at rest till such time as the weight *T* had again descended and permitted the click to regain its hold of the rachet wheel. The discharge of the click, in the first place, was effected by the raising of the weight *T*; for when the top *x*, of the pulley frame *S*, reached the rod *X*, it raised it, and, by means of the levers, disengaged the click. To counterbalance the weight of the wind-up frame *M*, one end of a short chain is fixed to the back of it; and after the chain is put over the pulley *Y*, at the top of the machine, a weight is hung on the end of the chain. It may be observed, that as the weight *T* has four feet to descend from the top to the bottom, its power upon the time-piece must be as much lighter when at the top, or heavier when at the bottom, as double the difference of the weight of so much chain; which would cause an irregularity in the going of the clock, as it had a balance and not a long pendulum.

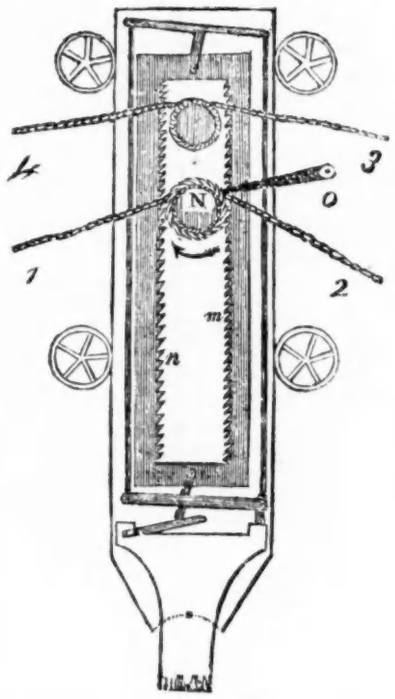

Fig. 3. WINDING-UP MECHANISM.

"To avoid this inconvenience, the weight *T* was made to wind up a smaller weight every twelve hours, by means of a *remontoir;* and this smaller weight, acting upon the time-piece, kept it in motion.

"The clock movement was of a common description. The balance spoken of consisted of a lever, supported by an axis at its center, and loaded at each end with a weight."

The above-quoted description gives a pretty clear idea of the driving mechanism of this curious clock, but it will be evident to skillful modern mechanicians, that, while its leading feature (the suspended barometer and cistern) is characterized by great originality and ingenuity, it would not be at all difficult to very greatly improve the means by which that idea is made effective for driving the clock; nevertheless, the construction shown was doubtless operative, and the clock deserves to rank among the most remarkable of the automata which have from time to time challenged the admiration of mankind.

It is evident that the very powerful movements of a barometer such as drives this clock, could be used to automatically register its own varying height upon a properly graduated fillet of paper, which could be moved at a uniform rate by the clock itself.

It is not improbable that this clock, after having indicated the lapse of time for 123 years, is still in use. Mr. Cox promised, in the prospectus of his lottery, that a report of its drawing should be published in the morning and evening papers of London; by consulting such report, some clue to the present ownership of this remarkable clock may possibly be obtained.

▲ ▲ ▲

Tests of a 300 Horse-Power De Laval Steam Turbine.

By the courtesy of the Edison Electrical Illuminating Co., of New York, we are enabled to lay before our readers the results of a recent acceptance test of a De Laval steam turbine at their Twelfth street station. It should be stated that the brake horse-power was obtained by assuming the efficiency of the dynamos to be 90 per cent.

The 300 horse-power steam turbine on which these tests were made was built by the Maison Breguet, of Paris, for the Société de Laval. Each 300 horse-power turbine drives, by means of gearing, two

100-kilowatt Desroziers dynamos, one on each side of the turbine shaft.

Operating with a steam pressure of 145 pounds to the square inch and a vacuum of 26 inches, the steam consumption operating condensing was to be not over 18.7 pounds per brake horse-power per hour.

The turbine disk has a diameter of about .75 meter (29.5 inches), and a thickness through the blades of about 10 millimeters (.4 inch). The turbine disk runs at a speed of about 9,000 revolutions per minute; the dynamos at 750 revolutions per minute.

The total equipment, comprising steam turbine, gearing and dynamos, occupies a space 4.05 meters (159 inches) long, 1.97 meters (77⅜ inches) wide, and 1.31 meters (51 inches) high.

Following is a summary of a six-hour full power test, the + and − referring to the dynamos on the + and − side of the circuit:

	Volts +	Amperes +	Volts −	Amperes −
Average readings.....	127.25	692.48	128.26	709.18

127.25 × 692.48 = 88118.080 watts + side
128.26 × 709.18 = 90959.427 " − "
total 179077.507 " both sides

179077.507 is 90% of 198975.01 watts = 266.72 H. P.

266.72 × 6 = 1600.32 H. P. hours.

Water discharged from air pump in six hours, 27,763 lbs.

$\frac{27\,763}{1600\ 31} = 17.348$ lbs. water per brake horse-power hour.

Pounds of water per electrical horse-power hour, 19.275.

Following is a test of the machine under reduced loads when operated with 2, 4, 6 and 7 jets. Duration of these tests, one hour each:

No. of Jets Used.	Average Load.		Average Watts.		% of Full Load.	Vacuum.	Pounds of Steam per E. H. P.
	+ Amps.	− Amps.	+	−			
2	153.78	147.15	18.707	18.283	18.50	27.	27.35
4	433 60	455.80	54 156	57.886	56.02	26.43	20.22
6	700.85	718.65	87.746	91.208	89.51	26.07	19.75
7	771.94	787.33	97 418	100.856	99.14	25.79	19.95

The Pneumatic Tire.

Most people are probably aware that Mr. Dunlop was anticipated in his invention of the pneumatic tire by a Mr. William Thompson, who took out a patent for the device about 1846. The curious thing, and one which is less generally known, is that the invention was very thoroughly tested, and shown to have great advantages, so far as the reduction of tractive resistance is concerned, over the tires ordinarily in use. Thus, in the "Mechanic's Magazine" of March 27, 1847, an account is given of a number of experiments made in the presence of the editor of that journal, which conclusively showed the superiority of the pneumatic system. A car fitted with the pneumatic wheels was drawn over a length of road in Regent's Park, half of the distance passed over being firm and smooth, and the remainder covered with newly broken stone. The tractive resistance on the smooth portion of the road was 28 pounds with the pneumatic wheels, and 45 pounds with ordinary wheels. On the newly macadamized portion of the road the pneumatic wheels showed a tractive resistance of 38½ pounds, and the ordinary tires one of 120 pounds. It was also shown that the wheels stood wear very well, as the car with which the experiments were made had been driven more than 1,200 miles over every kind of road, the wheels remaining in excellent condition. These wheels had an inner tube of soft rubber, and an outer one of leather, to take the wear; but in 1849 the leather was replaced by rubber, which was thickened on the tread, giving a tire apparently identical in all essentials with those in use to-day. It is most remarkable that an invention so thoroughly tested, and shown to have such advantages as this, should have been allowed to lie absolutely dormant for so many years. The very existence of the patent seems to have been forgotten till the re-invention of the device by Mr. Dunlop. Perhaps the fact that it was the horses and not human beings who would have profited at that date by the easy traction may have had something to do with it, as even now, when the pneumatic wheel is practically universally used for cycles, it is but seldom that horse vehicles are fitted with it. How far the existence of these old patents invalidates those since granted for the same invention, is a point on which it is, perhaps, best for an engineer not to express an opinion, as the action of the courts of law in patent matters is difficult to predict. The fault does not lie wholly with the lawyers, as the average expert witness aims at anything but telling the truth, the whole truth, and nothing but the truth.—"Engineering."

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At Portland, Me., a trial was had recently of a Hargrave kite or aëroplane of larger size and with greater success than heretofore recorded. A dummy weighing 150 pounds was carried to a height of 600 feet. A sudden gust of wind broke the retaining cord, and the kite sailed for a half a mile, descending easily and steadily.

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Paints for Metals.

An account of some interesting researches on the value of paints for ironwork, made by Professor J. Spennrath, has recently been published in the "Deutsche Bauzeitung." As one result of these, Professor Spennrath concludes that none of the metallic oxides commonly used combine chemically with linseed oil. The drying process depends exclusively on the absorption of oxygen by the oil, which is facilitated by the presence of the pigment in a purely mechanical way. The value of the different pigments used varies. Thus, zinc white, when used for outside work, rapidly swells to double its previous volume, owing to the absorption of carbonic acid gas and water. Sulphuretted hydrogen will cause red or white lead to act in a similar way, but, when pure, Professor Spennrath considers these two latter pigments satisfactory. Carbon paints are very stable, as in heavy spar, but the covering power of the latter is small. In order to test the relative durability of various paints, sheets of zinc were coated with a number of different kinds. The zinc was then dissolved away by acid, leaving a film of paint. All these films, it was found, could be destroyed by the action of dilute nitric, or hydrochloric acids, while the vapors of sulphuric and acetic acids acted similarly. Alkaline fluids and gases also destroyed the paints rapidly. Pure water was found to be more injurious than salt water; hence, the destructive action of sea water is to be attributed mainly to the mechanical effects of wash. Hot water was found to act more rapidly than cold. The most important discovery made was, however, the great influence of temperature. Films similar to those already described completely lost their elasticity and became brittle when exposed to a temperature of 203° Fahr. There was at the same time a large contraction. Similar effects are produced by prolonged exposure to considerably lower temperatures. Blistering he finds due to the inner coat of paint being so thick that it has not hardened thoroughly before the second coat is applied.—"Varnish."

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Commercial Review.

New York, Saturday Evening, Sept. 5th.

Dynamos and Motors.

One of the most favorable things that can be said about the present status of the electrical business is its better outlook occasioned by the distinctly improved tone prevailing in the realm of finance, and already extending to other lines of trade.

This more satisfactory trend of business is neither pronounced, certain nor old enough yet to have registered its effects at all deeply upon the electrical trade, which has become very quiet and is likely for some little time to remain so. Its state, however, is somewhat anomalous. It may be compared to that of a flat metal plate covered with water and heated; the water evaporates, and as it does so collects here and there in big globules, leaving the rest of the plate dry. Just so, the gradual withdrawal of demand for electrical machinery has left trade in spots

and streaks, and while some companies can see only barrenness and desolation, others are very well satisfied with their condition. And be it said that there are quite a number of the latter class.

Some of the larger companies appear to be receiving a smaller volume of orders than usual, and the shops are in a position to urge the offices rather than the offices the shops. It is reported that hardly any of the companies are running with a full force of men, but we are not sure how literally this ought to be taken. The Westinghouse works have recently laid off several hundred men; but the General Electric have about ninety per cent. of their force still at work, the diminution of the force by two hundred, last week, being in but one department; the Walker Company are running night and day; the Elwell-Parker Electric Company of America is very busy, and the same could be said of other companies. In some cases the factories may now be running entirely or partly full merely on the kinetic energy of earlier trade.

Of the different classes of electrical machinery, power motors are manifesting about the best tone of any. In some quarters there are even hints of improvement in this branch of the work. Electric lighting generators are not in active selling. Little work that is really new is being done in the street railway line, because new enterprises depend upon borrowed capital and loans are not at present the easiest thing in the world to obtain.

The export branch of the dynamo and motor market is apparently in a healthy state. It is not, indeed, recognized as such a leading feature of the business as is now the case with machine tools, but those companies who have entered it extensively report that this year has brought to it considerable improvement. This export business is in great measure carried on with South American countries, but some concerns have dealings with Europe, South Africa, Australia, etc. Instead of generalizing, we may consider what a few of them, individually, are doing.

An important phase of the Spanish American trade is the utilization of natural sources of water power by means of electrical distribution. A company who make alternating current dynamos have just shipped 1,000 horse-power of electrical machinery to Jalapa, Mexico, to be used for a 14-mile transmission for lighting and street railway purposes, coffee grinding and cotton mills, etc. For development of water power also they have shipped machinery within the last three weeks to Zacatecas, Mexico, to Venezuela, and to San Domingo, the latter a duplicate of a shipment made six months previous. They say one order brings another, and that they have not been trying very hard to push their export business. They are still running full time, having up to July been running both night and day, and are anticipating a good business.

A certain company who manufacture dynamos, power motors and other electrical goods, but one-half of whose business consists of fan motors, report about double the domestic and foreign trade of last year. Although they admit that trade is now dull and is likely to continue so until after the election, they are putting in larger shop orders and preparing for a

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Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

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whose names appear on our subscription list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

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Mech'l draftsman wants position; technical educated; exp'd office foreman. Box 287, AM. MACH.

Expert steam engineer wants position as chief of steam plant. Address BOX 263, AMER. MACHINIST.

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Wanted—Young man with shop experience to assist in piece work; office of factory. Apply to The Royal Electric Co., Montreal, P. Q.

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Wanted—Position by a first-class dftsman., technical graduate; has had two years' experience on railroad appliances and machy. Box 292, AM. MACH.

Toolmaker, age 30, desires position as assistant superintendent; experienced in typewriters; capable of taking charge. Address Box 284, AM. MACH.

Wanted—Position as chemist, 23 years old, college education, four years' experience in large steel and iron works; best references. Box 293, AMERICAN MACHINIST.

Position at small salary, about Sept. 15th, in line of mechanical engineering, by young man, age 23; good technical education and fair draftsman. Address Box 273, AMERICAN MACHINIST.

Wanted—Position with some reliable mfg. company to develop new motor carriage; have new motor and generator (gasoline); will make liberal arrangements. Address Box 286, AM. MACH.

Wanted—Position as superintendent of foundry and machine shop or iron and wood-working establishment, by mechanical engineer of extensive experience. Address Box 268, AMERICAN MACHINIST.

I would like to hear from party desiring service of thoroughly up-to-date foundry foreman on light or heavy work; if you need such a man, drop me a line and get full particulars; good references. Box 289, AMERICAN MACHINIST.

Wanted—Two thoroughly competent salesmen for presses, drop presses, rolling mills and wire drawing machinery; preference given to those with established trade; exceptional opportunity to the right men. Box 294, AMERICAN MACHINIST.

Mechanical engineer wanted as superintendent for shop in Sweden for manufacturing all kinds of machine tools, such as lathes, milling machines, planers, etc.; must be A 1 expert on such machinery; Swede preferred. Box 295, AMER. MACHINIST.

Experienced mechanical engineer of Pittsburg, familiar with design and const'n of all iron and steel wks.' mach'y and having good acquaintance among the trade, wants to represent mach. shop or manfr. desirous of reach'g this sect'n. Box 257, AM. MACH.

Business—A gentleman with means and undoubted reference would like to form a connection with parties desiring to be represented in the Pacific States. The party is more particularly conversant with machinery, but has spent many years in mercantile pursuits. State in answer line of manufacture you desire to introduce. Address P. O. Box 2055, San Francisco, Cal., and if satisfactory, correspondence or personal visit will follow.

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S.M.York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

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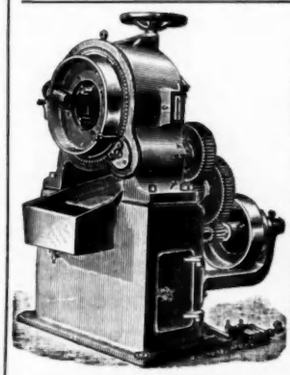

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Near Broadway,
New York.

lively business next year. Another concern speaks of having shipped quite a number of fan motors to South America.

A large local supply manufacturing company, making dynamos and motors as well, report that, although the volume of their export trade is very much smaller than that of domestic, it shows relative improvement this year, as compared with the latter. Their business with Spanish America has been better this year in electric lighting material than ever before, and in other classes of manufactures, about as good as ever. The home supply trade they have found better than that in dynamos and motors.

Although it does not seem from all points of view as though the export trade to Europe were a feature of the business, there is evidently a good demand from that quarter for street railway machinery. The General Electric and the Walker Companies have had a good demand for machines for that purpose. Among a list of the recent orders and shipments of the latter company we notice motor equipments for Paris and Hamburg, besides a dynamo, probably for lighting purposes, to be sent to Cochin China.

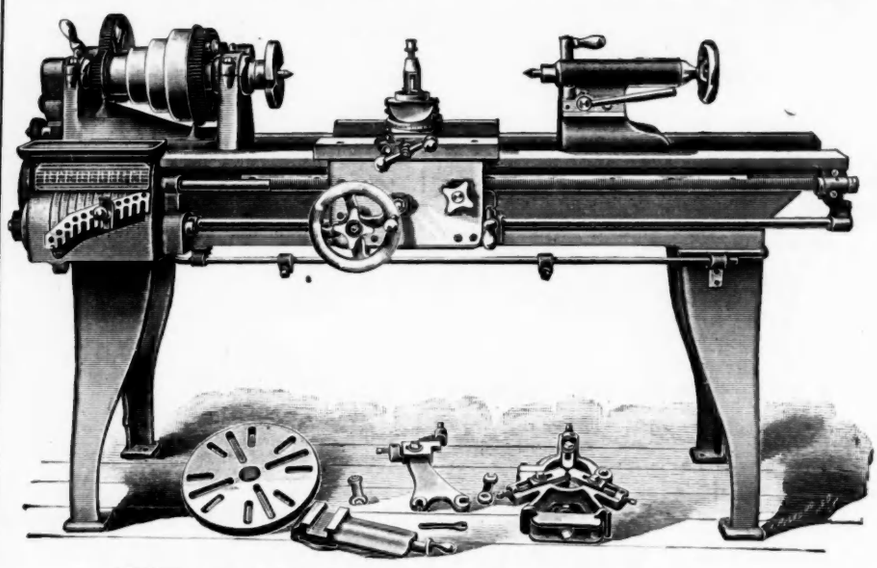
We feel constrained to add a few words more to the many that have been printed, within the last few days, about Li Hung Chang, and say that the results of his visit to this country should be awaited with interest by ambitious manufacturers. Without discussing the truth of the reports that one object of his American tour is to order the building of vessels of war for the Chinese government, it is certain that his general tone is such as to augur much to hope for in the future commercial policy of China. In a press interview he remarked: "You make better machinery than that of the other nations, but unfortunately it is dearer." Notwithstanding the latter clause and the moral which he went on to draw, that we ought to employ Chinese labor, such recognition of the merits of American machinery is an encouragement to its extension in the Celestial Empire.

The administrative council of Egyptian railways are desirous of receiving bids from Americans for a line to be constructed in that country, and in a consular report to the State Department at Washington are contained specifications for furnishing and laying the iron girders.

We give an advance report of the exports of machinery from New York for the month of August. The amount we compute at $830,950. This includes some items delayed from the July returns, and some August shipments are yet to be reported. An official report for the entire country will later be published.

Mr. Mark Flather, president of the planer company of that name, at Nashua,

(Continued on page 39.)



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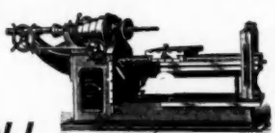
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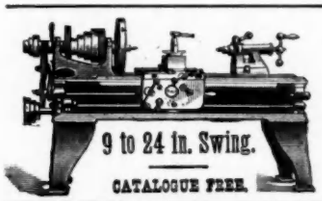

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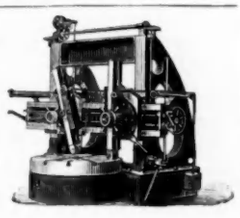

(*Continued from page 38.*)

N. H., writes us as follows: "Business in general in this section is very quiet with little prospect of improvement until after election. Inquiries are coming in more freely, but when they are looked after the customers say they do not intend to place any orders until after November first. Regarding our own factory, we have had all the work we could do for the last eighteen months with a full complement of men, while in some departments the orders on our books will last for six months. A large percentage of the orders we have had, however, were for shipment."

Iron and Other Metals.

The hint given in the last week's report of a somewhat improved tone in the iron market is corroborated by other authorities, and it is perhaps not rash to affirm that the turning point of the market has finally been passed.

All the mills of the Edgar Thompson works of the Carnegie Company at Braddock have suspended operations, because of lack of orders, and it is reported that seven of the nine blast furnaces of the Carnegie's Braddock plant are to be banked soon.

Not enough business is now being transacted in the metal market generally to stiffen prices. Lead, however, is regaining some of its lost ground.

Quotations.

NEW YORK, Saturday, September 5th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 75 @ $13 00
No. 2 foundry, Northern	11 25 @ 12 00
No. 2 plain, Northern	10 50 @ 11 00
Gray Forge	10 50 @ 10 75
No. 1 foundry, Southern	10 75 @ 11 25
No. 2 foundry, Southern	10 25 @ 10 75
No. 3 foundry, Southern	10 00 @ 10 25
No. 1 soft, Southern	10 15 @ 10 50
No. 2 soft, Southern	10 25 @ ....
Foundry forge, or No. 4 Southern	9 75 @ 10 00

Bar Iron—Base—Mill price, in Carloads, on dock; common, 1.10 @ 1.20c.; refined, 1.20 @ 1.35c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.70c.

Tool Steel—Ordinary sizes, standard quality, 5¾ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—From store, about 1.75. Special brands upward.

Cold Rolled Steel Shafting—Base size in carloads, about 2½c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 10⅝ @ 10⅞c.; electrolytic, 10⅜ @ 10⅝c.; casting copper, 10⅛ @ 10⅜c.

Pig Tin—For 5 and 10-ton lots, 13.40 f.o.b.

Pig Lead—In carload lots, 2.75c.

Spelter—In carload lots. New York delivery, 3.62½ @ 3.65c. for standard Western brands.

Antimony—Cookson's, 7½c.; Hallett's, 6.40c.; Japanese, 6.40c.

Lard Oil—Prime city, present make, 39 @ 40c.

▲ ▲ ▲

Manufactures.

Tekousha, Mich., will put in an electric light plant.

Hastings, Mich., will put in a system of water works.

H. W. Scott, Floyd, Va., will erect a flouring mil and install new machinery.

Osgood & Wagner, Carlisle, Pa., will start a new shoe factory, and install new machinery.

The Washington Novelty Mfg. Co., Washington, D. C., will erect a plant and install new machinery.

The Connellsville Lock Co., Connellsville, Pa., will erect a lock plant, and install new machinery.

The Ontonagon Electric Light Co., Ontonagon, Mich., will erect a $50,000 plant for lighting purposes.

Planters' Rice Mill Mfg. Co., Savannah, Ga., will shortly install a line of new and improved machinery.

The city of Reading, Pa., will erect a garbage crematory, and will place machinery of an improved type.

The Capital Traction Co., Washington, D. C., will erect an electric plant, and place new and improved machinery.

The Union Shoe and Leather Company, of Winnipeg, Man., propose increasing their factory and adding new machinery.

A. E. Preston and F. A. Kirby, of Battle Creek, Mich., have formed a partnership to manufacture wire nails and wire nail machinery.

H. Keppel & Son, of Zeeland, Mich., will erect a flouring mill at a cost of $75,000. Engines, pumps and milling machinery will be installed.

The Solvay Process Co., Syracuse, N. Y., are constructing another large addition to their plant, three stories high, and 192 feet by 90 feet.

At St. John, N. B., The Maritime Cold Storage Co. is being incorporated with a capital of $90,000. They have applied for a site at Sand Point.

A company, under the title of The Standard Fibre Lining Company, Ltd., is seeking incorporation, to manufacture fibre pulp and paper at Manitou, Ont., Canada. Capital $40,000.

Messrs. Flinn & Hulcher, of Battle Creek, Mich., have closed a contract with Vicksburg, Mich., for 50 arc and 500 incandescent lights. The town will also put in a system of water works.

At Syracuse, N. Y., the Central City Light and Power Co. has been formed. Capital $125,000. Directors, Eugene Hughes, John F. Gaynor, Wm. B. Kirk, Anson E. Alvord, Hamilton S. White.

The Preston Gold Mining Company, Ltd., of Seine River, are seeking incorporation to operate a general mining business, with a capital of $50,000, and chief place of business at Rat Portage, Ont., Canada.

E. V. Everette, Aughenbaugh & Co., Waseca, Minn., will erect a large flouring mill at a cost of $175,000, to replace one recently burned. New engines, pumps and milling machinery will be installed.

F. R. McMullin Mfg. Co., Chicago, Ill., intend to fully equip an entirely new shop with the most improved machine tools. Mr. Chas. T. Hildebrandt has been appointed to the position of general superintendent.

The Lansing, Mich., Iron and Engine Works has been reorganized, Judge Vernon H. Smith, pres., Ionia; Harris E. Thomas, vice-pres. and gen'l mgr.; Arthur Woodmancy, secy. and treas., with a capital stock of $100,000.

United States Air Refrigerating and Power Co. has been incorporated at Newark, N. J., with capital of $100,000, to manufacture and deal in pneumatic appliances for refrigerating and power purposes. Wm. Clinton Burling is president. The factory will be located in Brooklyn, N. Y.

The Armington & Sims Engine Co., of Providence, R. I., have been forced to make an assignment, and it is feared will not be able to resume business. We understand that the failure is not due solely to want of success in the business itself, but partly also to complications with other unsuccessful enterprises.

Wm. Johnson, of Montreal; Geo. McAvity, St. John; John D. Chipman, St. Stephen; Frederick P. Thompson, of Fredericton; J. T. Dibblee, of Woodstock, and Joshua Peters, Moncton, have applied for letters of incorporation under the title of New Brunswick Cold Storage Co., Ltd. Capital $300,000, and chief place of business St. John, N. B.

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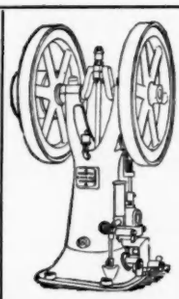

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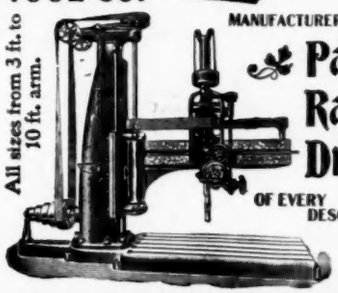

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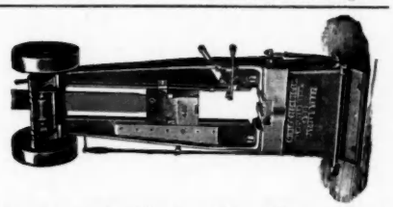

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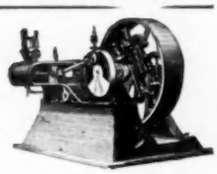

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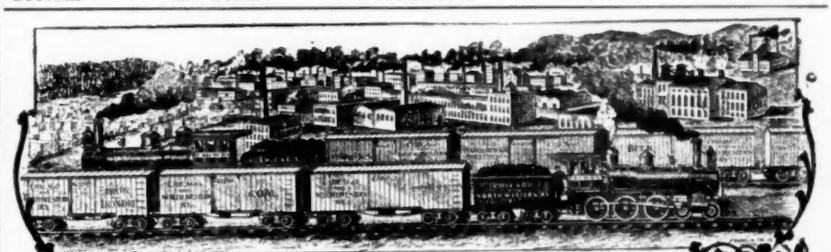

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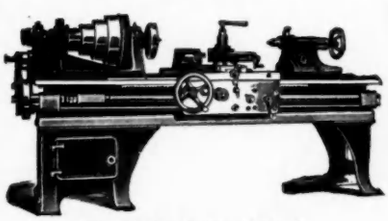

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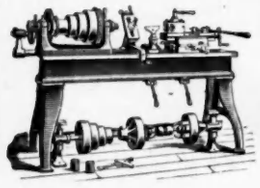

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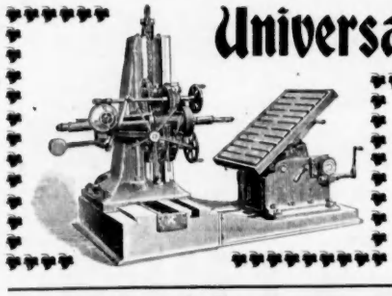

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